Technical Report 88-02

MARKET ANALYSIS OF CTA FARE STRUCTURE OPTIONS

SUMMARY REPORT

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PREFACE

This report includes 4 papers presented at the June, 1988 Metropolitan Conference on Public Transportation Research at the University of Chicago.

These papers provide a convenient summary of fare-related market surveys and analyses conducted during 1987, primarily by the consultant team of LTI Consultants Inc./E.A. France and Associates.

"Definition and Analysis of CTA Market Segments" describes an analysis of existing data sources, including reprocessing of the 1979 CTA Origin-Destination Survey to yield trip length and geographic distribution market characteristics.

"Sensitivity of CTA Market Segments to Fare Changes" defines the CTA transit market according to trip purpose (work/non-work), central area orientation, journey distance, and mode (bus vs. rail). Fare elasticities based on analysis of stated preference survey results, for each market segment, are presented.

"1987 Trip Diary Survey: Pass vs. Cash-Fare" reports the results of two separate CTA passenger surveys, and documents transit trip frequency, time-of-day of travel, trip purpose, household income, household size, autos available, race, and age for each.

"Evaluation of CTA Fare Structure Options" summarizes the assessment of six basic options, three of which represent alternate approaches to charging fares based on distance travelled. Options which involve a peak/off-peak fare differential and a bus/rail fare differential ranked highest, followed by increased prepayment of fares via passes and tickets.

DEFINITION AND ANALYSIS OF CTA MARKET SEGMENTS

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1. INTRODUCTION

The objective of this part of the Fares Structure Analysis by LTI Consultants for CTA was to explore all available existing data sources, and to extract journey information which would be the basis upon which demand tools would be formulated.

The base journey information covered the following categories: peak and off-peak, central area and non-central area, distance, bus and rail, and fare type. The first three were the most relevant to the CTA as market segment categories and will be explored in detail. Before they are discussed, an overview of CTA ridership patterns is presented.

1.1 Total CTA Ridership

The total CTA ridership was defined in terms of the number of journeys made on the system per year. A journey was defined as a linked trip comprised of one or more rides from an origin (such as home) to a destination (such as work).

The annual total was estimated from data extracted from GFI fareboxes for bus journeys and VISIFARE equipment for rail; it was assumed that each fare collected represented one journey. For journeys made using a monthly or 14-day pass, the estimate was based on the number of unlinked pass trips recorded by GFI and VISIFARE and then calculated using an average of 1.58 unlinked trips per journey derived from the 1986 CTA Trip Component Survey. This provided annual total ridership figures as follows: 228 million cash and 132 million pass journeys. This yielded a total of 360 million journeys.

1.2 Bus and Rail Ridership

CTA ridership was further divided into bus and rail categories. Rail journeys included those involving bus trips to and from rail stations. Bus journeys were those involving only bus trips.

Cash journeys were split into these two modes by identifying the number of cash fares collected on buses and at stations. Bus/Rail journeys were estimated by extracting the number of rail differential fares collected by station agents. It was assumed that on average, an equal number of rail/bus journeys would be made in the opposite direction.

An alternative method used to estimate the bus/rail split was based on the 1979 Origin and Destination (O/D) Survey data. Rail journeys were extracted from this data base by identifying all respondents who either received a questionnaire on rail or who gave rail as their onward mode of travel. (They were only supposed to complete a questionnaire received on the first trip of their journey).

2. PEAK AND OFF-PEAK RIDERSHIP

The bus and rail ridership were subdivided into peak and off-peak markets. The peak was defined as AM and PM weekday peaks and primarily covers journeys to and from work. The off-peak was defined as all other times, including middays and evenings during the week, weekends and holidays. Weekdays were split into peak and off-peak based on the ridership hourly counts taken by CTA in 1984.

Weekend traffic was extracted separately from GFI/VISIFARE ridership data. Tables 1 and 2 show typical weekday ridership annual totals, splitting peak/off-peak.

TABLE 1
DAILY RIDERSHIP BY MODE AND TIME PERIOD

MODE	PEAK	OFF-PEAK	ALL DAY
BUS			
Journeys (000)	322	345	667
Percent	27.5	29.5	57
RAIL			
Journeys (000)	296	207	503
Percent	25.3	17.7	43
TOTAL			
Journeys (000)	618	552	1171
Percent	52.8	47.2	100

TABLE 2

ANNUAL RIDERSHIP BY MODE AND TIME PERIOD
(MILLIONS OF JOURNEYS)

	WEEKDAY			WEEKEND	ALL WEEK
MODE	PEAK	OFF-PEAK	TOTAL	TOTAL	TOTAL
BUS	84	90	174	36	210
RAIL	78	54	132	18	150
TOTAL	162	144	306	54	360

3. GEOGRAPHICAL DISTRIBUTION

The geographical distribution of CTA ridership in terms of travel patterns and journey lengths was estimated using 1979 O/D Survey and the 1980 Census Journey to Work Survey. Both sources provided data for the peak. The study had to rely on the 1979 O/D survey data for off-peak periods. Both sources were analyzed on a common basis for comparison.

To aid examination of the data, the CTA service area was divided into 12 zones. The zone structure identified 5 main corridors; north, north-west, west, south-west and south, leading to two concentric central zones. The two innermost zones were identical to those adopted by the Chicago Area Transportation Study.

Zone 1 was the Central Business District (CBD) bounded by Kinzie, Harrison and the Chicago River on the west and Lake Michigan.

Zone 2 included the remainder of the Central Area surrounded by North Avenue, Cermak and Ashland.

Zones 3 to 7 covered the inner sections of the study area.

Zones 8 to 12 covered the outer sections.

Four of the five corridors were based on associated CTA rail services, while zones 6 to 9 enclosed the South-West corridor presently served by express bus services.

The area of analysis broadly corresponded to that of Cook County. Data were extracted in two forms: (1) An origin-destination matrix based on the 12 zones defined above and (2) A distribution of journey distances based on mile bands.

These data were divided by mode and, from the 1979 O/D survey data, by the four periods of the day--the morning and evening peaks, and the midday and evening off-peak periods.

The journey matrices were then analyzed in three markets.

1. A radial market, including all journeys longer than 2 mi. either starting or ending in the Central Area.

2. A local market including all journeys longer than 2 mi. both starting and ending outside the Central Area.

3. All journeys of less than 2 mi. Walking would be a competitive mode up to this distance effectively introducing a separate market.

For rail, the radial market dominated, reflecting its good access to the Central Area relative to other destinations (Table 3). For bus, there was less emphasis on radial movement and the local market dominated in the off-peak. Considering all CTA services, the radial market represented 56% of the total, falling to 42% in the off-peak.

The CTA had a significant short journey market for off-peak bus journeys: 35% are less than 2 miles, whereas, for peak rail journeys, this proportion falls to 11% (Table 4). Once short journeys have been extracted, the dominance of radial trips in all markets is highlighted. For peak journeys over 2 miles, those to the Central Area dominated journeys to other destinations by approximately 2 to 1.

TABLE 3
WEEKDAY JOURNEYS BY MARKET SECTOR
(PERCENTAGES)

MARKET	BUS		RAIL		CTA	
	PEAK	OFF-PEAK	PEAK	OFF-PEAK	PEAK	OFF-PEAK
CENTRAL	9	10	3	5	6.1	7.7
RADIAL	49	37	63	50	56.0	42.1
LOCAL	42	53	33	45	37.9	49.7
TOTAL	100%	100%	100%	100%	100%	100%

TABLE 4
WEEKDAY JOURNEYS BY MARKET SECTOR INCLUDING 2 MILE DISTANCE MARKET
(PERCENTAGES)

MARKET	BUS		RAIL	
	PEAK	OFF-PEAK	PEAK	OFF-PEAK
>2 MILES				
o CENTRAL	0.2	0.2	0.2	0.2
o RADIAL	45.6	33.3	61.6	48.1
o LOCAL	26.4	30.4	26.3	33.3
< 2 MILES	25.5	35.0	10.9	18.1
TOTAL	100%	100%	100%	100%

4. DISTRIBUTION OF JOURNEY LENGTH

The data from the 1979 O/D Survey were extracted by one mile distance bands for bus and rail, and for the four periods of the day. When comparing the average journey length by mode and period, on average, rail journeys are approximately 2 miles longer than bus journeys, and peak journeys are about one mile longer than off-peak journeys. (See Table 5). One curious feature of these figures is that the average bus journey in the morning was almost one mile longer than in the evening.

Bus journeys had a much sharper peak around 2 miles compared with rail journeys which had a flatter, more even distribution (Figures 1 and 2). Both morning and evening peak rail journey lengths rose gradually to a maximum around 9-10 miles (e.g., from Chicago Loop to 79th - 87th Streets on the south), after which there was a steep decline. There was a striking difference between bus and rail journey length distributions, a sharp peak around 2-3 miles, followed by a plateau up to around 8-9 miles for bus journeys, and a pronounced peak around 7 miles followed by a sharp reduction for rail.

TABLE 5
Average Journey Length

Time of Day	Bus	Rail
Morning Peak	5.8 (5.8)	7.5 (8.0)
Evening Peak	4.9	7.7
Peaks	5.5	7.6
Midday	4.4	6.1
Evening	4.4	6.5
Off-Peak	4.4	6.2
All day	4.8	6.7

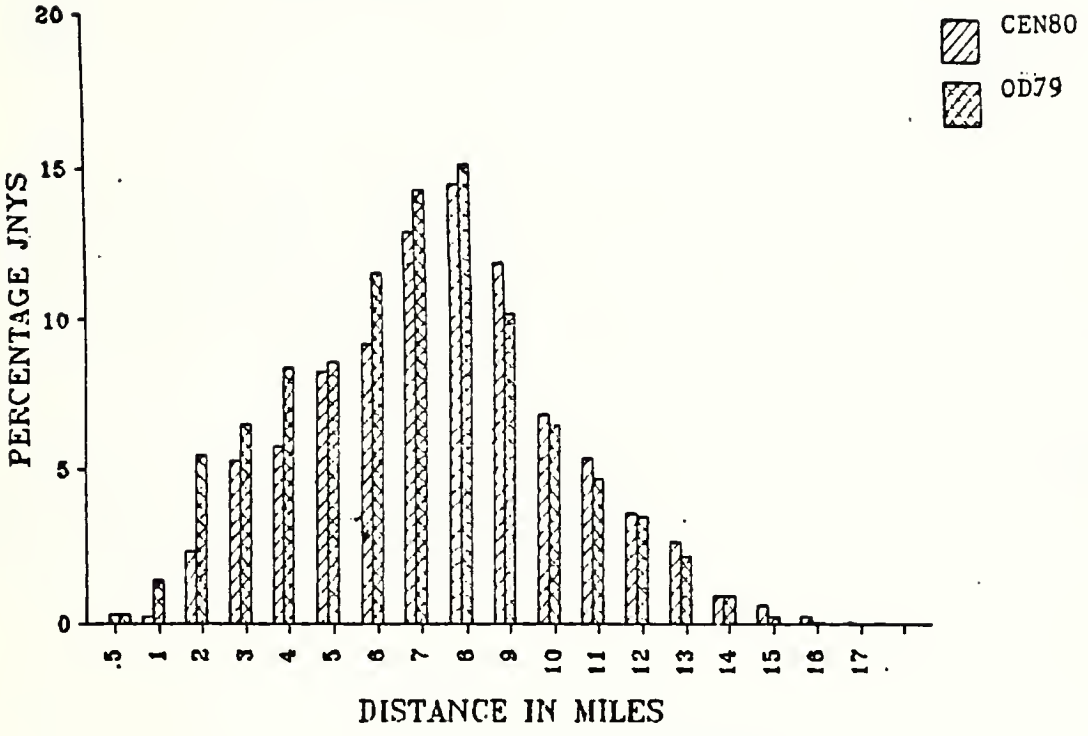
Figures in Brackets are from 1980 Census

Radial trips were about 2 miles longer on average than local trips, for both bus and rail journeys (Table 6). It was surprising that there was so little difference in journey length between bus and rail, for central, radial, and local trips. There was a dramatic difference between local and radial car journey lengths (Table 6). Whereas radial car journeys were evenly distributed over the 1 to 18 mile distance bands, local journeys had an extreme peak around 2 to 3 miles. This was in marked contrast to the distribution for transit.

FIGURE 1

JOURNEY LENGTH DISTRIBUTION AM PEAK

RADIAL RAIL JOURNEYS



RADIAL BUS JOURNEYS

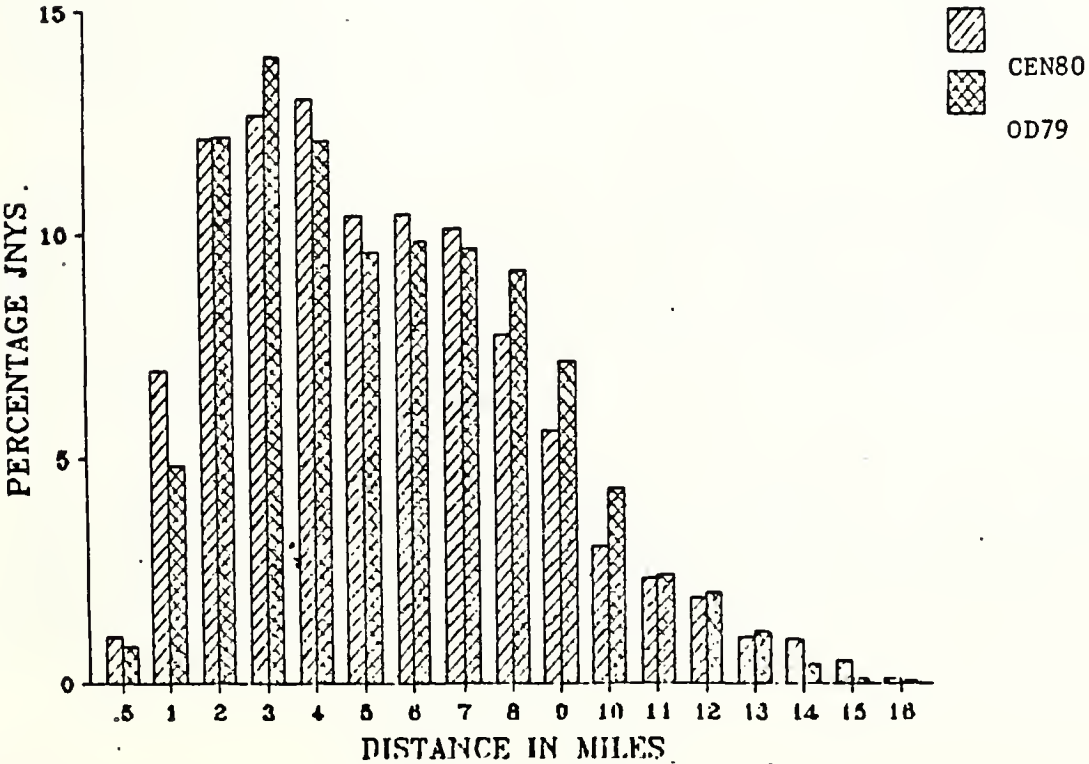


Table 6
Average Journey Lengths
(miles)

Market	Morning Peak			Off-Peak		
	Bus	Rail	Car	Bus	Rail	Car
Central	1.4	1.5	1.7	1.3	1.4	1.3
Radial	6.5	7.8	8.6	6.0	7.5	7.5
Local	4.3	5.9	5.8	3.8	5.3	2.9

There was a difference in both average journey length and shape of the distribution for local rail journeys (Figure 3). The distribution from the 1979 O/D Survey had a sharp peak around 3 to 4 miles, whereas the distribution from the 1980 Census was much flatter. It was likely that a number of bus/rail journeys in the 2 to 5 mile band were defined as bus journeys in the 1980 Census.

Car and rail had a similar distribution with a peak around 9 miles, but cars had a larger share of the market and a slightly longer average journey length (Figure 4). Bus trip lengths were more skewed, with a peak around 6 miles.

5. CTA'S COMPETITIVE POSITION

To estimate the sensitivity of CTA's ridership to fare changes, data on car journeys were extracted from the Census information so insight into relative modal competition in each of the market segments was gained. These data included all journeys made to work by car, either as a driver or passenger. CTA serviced its highest share for the radial peak market, at 60%; and lowest for the local off-peak market, at 20%.

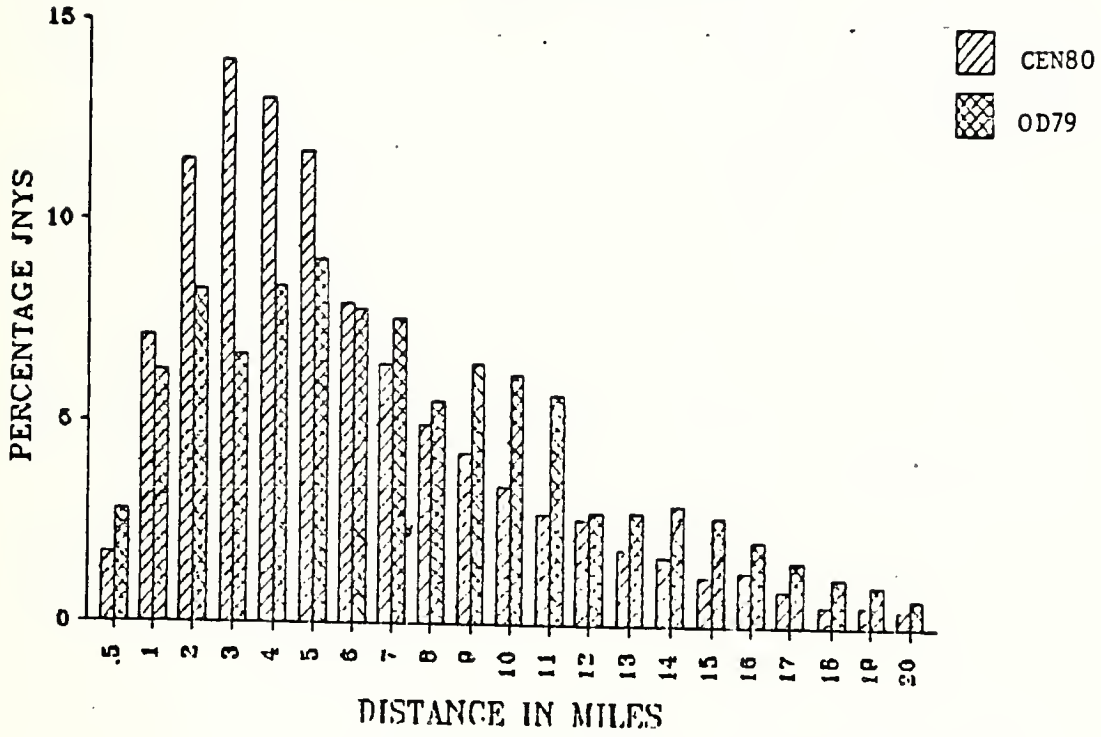
When the CBD was considered in isolation, CTA's market share rose to 77%. For the Central Area excluding the CBD, the market share fell to 52%. This highlights the difference between the two zones contained with the Central Area. Within the Loop, parking was limited and costly. CTA services provided good access to this area, particularly by rail, and enjoyed a healthy competitive position. In other parts of the Central Area, parking was more freely available.

The relative competitive position of CTA services within the various corridors revealed an unanticipated result. In the peak, CTA attracted a higher share for the outer zones compared with the inner zones. Overall, there was little variation between corridors.

FIGURE 3

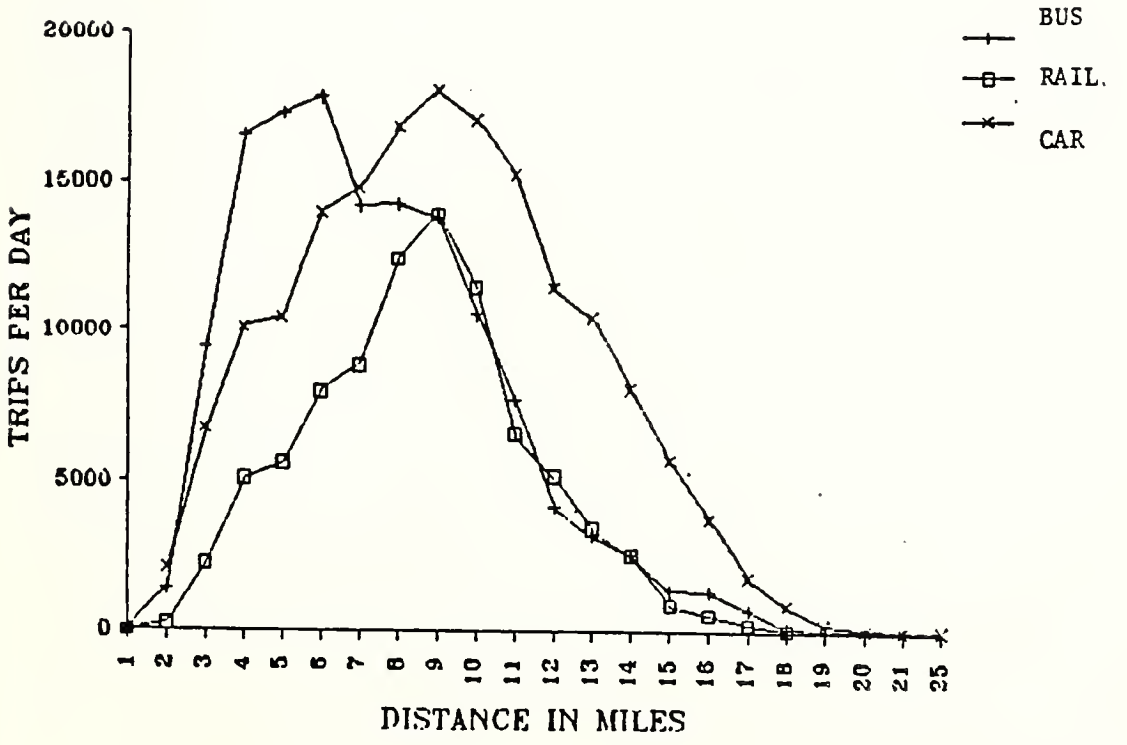
JOURNEY LENGTH DISTRIBUTION AM PEAK

LOCAL RAIL JOURNEYS



JOURNEY LENGTH DISTRIBUTION 1980 CENSUS

WORK JOURNEYS TO CBD



6. CONCLUSIONS

The analysis of journey data quantified the size of the various markets for CTA bus and rail services. It was readily apparent that CTA services are most competitive in the radial markets, attracting 60% of journeys in the peak, and 56% off-peak. This market represented around 50% of CTA's total weekday traffic.

The CTA's competitive position was weakest in the local off-peak markets, attracting 20% of the market. This represents about 43% of CTA's total weekday traffic.

In terms of distance, CTA services attracted the lowest market share for short journeys of less than 4 miles.

In the Central Area market, CTA services attracted mode shares of only 31% (peak) and 14% (off-peak), even ignoring walking. This was surprising given the density of the network and the cost of parking.

These conclusions present a direction for the focus of further market analysis and breakdown of ridership. They also highlight issues for relative emphasis in providing further service.

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Sensitivity of CTA Market Segments to Fare Changes

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SENSITIVITY OF CTA MARKET SEGMENTS TO FARE CHANGES

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ABSTRACT

As a part of a recently completed Fare Structure Analysis for the Chicago Transit Authority, several different market segments were defined on the basis of trip purpose (work versus non-work), central area orientation (radial or local trips), and journey distance. These market segments provide a basic framework for further analysis of CTA's existing and potential ridership patterns. This paper reports on a market segment analysis of relative sensitivities to fare increases. Results of stated preference surveys conducted in 1987 of work and non-work travelers within the CTA service area are highlighted.

This analysis of fare elasticities is also based upon observed behavioral change, for both cash fare passengers and pass users, associated with three prior CTA fare revisions: January 1981, June 1981, and January 1986. Derivation of and consistency among fare elasticites for both bus and rail passengers, and distinguishing cash fare from pass price sensitivities, are reviewed.

Fare elasticities by market segments will be used in future analyses of CTA fare structure options and fare increases. These reflect such findings as off-peak elasticities more than twice as high as peak elasticities, bus travel elasticities nearly three times as high as rail travel elasticities, radial travel markets with lower fare elasticities than local markets, with a higher difference in the peak, and journeys of less than 2 miles exhibiting a higher level of sensitivity to fare change.

1. INTRODUCTION

In a recent evaluation of fare structure options for the Chicago Transit Authority (CTA), it was vital to gain a better understanding of the relative sensitivities of CTA riders (and non-riders) to different fare strategies. While recent experience with necessary fare increases since 1981 permitted the derivation of relative fare elasticities among bus and rail passengers, no CTA-specific behaviorial data existed regarding differences in peak-hour versus off-peak sesnsitivities, or in radial (CBD) versus local geographic orientations. Furthermore, little data existed regarding potential responses to distance-based fares, though the region's commuter rail service has charged suburban fares in this way for many years.

While some information was available in the literature regarding these different temporal, geographic, and distance-based market segments, additional stated preference survey work was undertaken in the CTA service area to provide current information regarding potential responses to different basic fare structure options. The results of these surveys were specific to the CTA service area, particularly with regard to the apparent lack of sensitivity to fare increases related to distance traveled. Otherwise, results of the stated preference survey work are generally consistent with findings reported elsewhere in the literature.

Using these results, together with historical analysis of ridership response to three recent CTA fare increases, several elasticities were derived for use in systematically analyzing potential ridership response to future CTA fare structure options. This paper reports on the ridership and survey data analyses from which these elasticities were derived.

2. CTA RIDERSHIP RESPONSE TO RECENT FARE CHANGES

Fare revisions and responses to them provide a valuable source of data for analyzing demand behavior and deriving elasticities to predict the outcome of future revisions. The most useful indicators are farebox revenue and passenger trips corresponding to the periods before and after a fares revision. Ideally, such information would be disaggregated between major modes and/or fare payment types.

This section reviews:

o Recent fare revisions in Chicago,

o Elasticity estimates derived from the recent CTA fares revisions, and

o Cross-checks against annual CBD cordon passenger counts.

2.1 Recent CTA Fare Revisions

From 1980 to 1987 there were three fare increases, with the first two very close together. Table 1 details these fare increases by the four main fare payment categories.

Each increase reflected different policy aims:

o January 1981

- A 16% pass price rise compared with 33% for cash fares;
- Resultant encouragement of increased pass usage.

o June 1981

- A slight relative increase in pass price (14%) compared with cash fares (12%).

o January 1986

TABLE 1

CTA FARE INCREASES, 1980-1986

DATE/AMOUNT OF INCREASE	PASS $/MONTH	PRICES BUS $	PRICES RAIL $	PRICES TRANSFER $	TOTAL % CHANGE
1980 - Base	30.00	0.60	0.60	0.10	
Jan. 1981	35.00	0.80	0.80	0.10	
- % Change	16%	33%	33%	28%	30%
June 1981	40.00	0.90	0.90	0.10	
- % Change	14%	12%	12%	11%	12%
Jan. 1986	46.00	0.90	1.00	0.25	
- % Change	15%		11%	18%*	18%

Notes:
1. Percentage Change is the percentage increase over the previous fare.
2. * Increase in transfer price was 25% for bus/rail and 15% for rail/bus.

TABLE 2

DEMAND EFFECT OF CTA FARE INCREASES (UNLINKED TRIPS)

DATE OF INCREASE	Trips Unlinked '000s PASS	BUS CASH	RAIL CASH	PASS & CASH BUS	PASS & CASH RAIL	TOTAL	BEFORE & AFTER PERIOD
Jan 1981	46	195	59	230	70	300	First half
Increase	+23	-32	-7	-15	-1	-16	1980/1981
% Change	50%	-16%	-12%	-6%	-1%	-5%	
June 1981	52	110	34	150	46	196	Second half
Increase	-10	-4	+1	-12	-1	-13	1980/1981
% Change	-20%	-4%	2%	-8%	-2%	-7%	
Jan 1986	164	304	107	428	147	575	Feb. 1985
Increase	+35	-48	-16	-21	-8	-29	Feb. 1986
% Change	22%	-16%	-15%	-5%	-7%	-5%	

- No change in bus fares;

- Pass price increase (15%) higher than rail cash fares increase (11%);

- The bus/rail transfer price increase (25%) was more than for rail/bus (15%); and

- Change in transfer regulations, from allowing unlimited rides in a fixed time to a limit of two riders, excluding route of issuance.

The effects on demand for CTA service varied with each fare adjustment (Table 2).

o In January 1981, there was a big increase in pass take-up due to its relative decrease in price.

- Bus/rail cash trips dropped by 16% and 12%, respectively. It was likely that many of these passengers switched to using passes.

o Following the small relative increase in pass price in June 1981, usage dropped temporarily by 20%.

- Bus cash trips fell by 4% and rail cash journeys showed a slight increase (2%).

- The transfer add-on remained constant at 10 cents; this made transfer trips the cheapest relative deal after this fares revision.

- It was likely that many pass users moved back to using transfers.

o By 1986, pass usage was back to its pre-June 1981 level, and received a further boost in 1986 when bus/rail transfers increased by 25% compared with 15% for passes, and tightened transfer rules limited their utility for many riders.

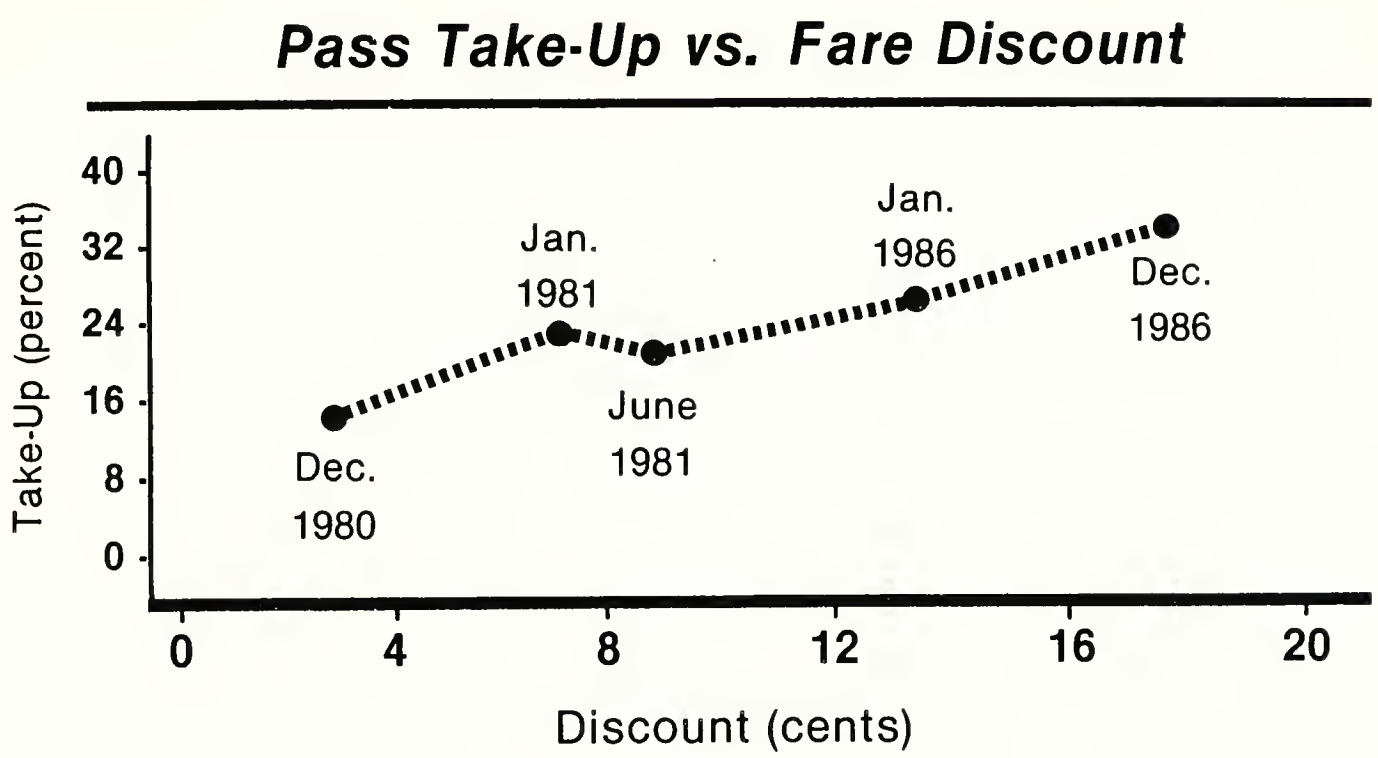
2.2 Pass Use Since 1980

Pass take-up (share of unlinked rides by pass) was sensitive to the relative cost per trip of passes compared to cash. This was reflected in ridership changes following the fares revisions in Chicago from 1980 to 1987 (Figure 1).

o In each fare change, pass take-up responded to relative changes in the discount of passes compared to cash fares. The x-axis in Figure 1 is the change in discount per unlinked trip, calculated at each fare level as the difference between pass receipts per unlinked trip and each cash price.

o The January 1981 revision increased the pass discount by about 4 cents, from 3 to 7 cents, which increased pass take-up from about 15% to about 24% on both modes.

Figure 1


Pass Take-Up vs. Fare Discount
Take-Up (percent)
40
32
24
16
8
0
Dec.
1980
Jan.
1981
June
1981
Jan.
1986
Dec.
1986
0
4
8
12
16
20
Discount (cents)

- The effect of the mid-1981 revision was les marked. Passes became slightly more attractive to rail travelers, while their value compared with bus was unchanged, yielding a slight drop in pass use.

- The 1986 revision improved the pass discount by 4 cents to 16 cents, contributing to a further substantial increase in take-up to about 33% of unlinked rides.

Clearly demand for passes among CTA users was sensitive to discount levels relative to cash fares. CTA can exploit this demand sensitivity to achieve policy objectives in prepayment ticketing and fares flexibility.

2.3 Elasticities of Demand

The behavioral changes summarized above have been used to derive fare elasticities, simply by relating the change in demand for trips (T) to the change in fares level (F), i.e.

$$\text{Elasticity} = \frac{(T1 - To)/To}{(F1 - Fo)/Fo}$$

Thus, if a 3% trip loss followed a 10% fares increase, elasticity was estimated at -0.3.

The fares increase in Table 3 was the overall average CTA price increase, with the figure for 1986 broken down to reflect the price discrimination between bus and rail. Trip losses (Table 3) are given by mode as are the elasticities (Table 4).

The ratio of net gain in farebox receipts to price increase was surprisingly consistent over the three increases (0.63, 0.66, 0.65).

- Under the 1987 fare structure, it would be possible to make a robust estimate that the net receipts gain from a fares rise will be roughly two-thirds of the overall average fare increase.

- In January 1981 the surprisingly low elasticity of -0.17 reflected a low level of lost trips despite the high (30%) average fare increase. The large increase in discount for passes encouraged riders to switch fare payment method rather than mode. Additional discretionary trips may also then have been made by new pass users. Rail trips in particular were hardly affected.

- The June 1981 fares revision, though smaller than the earlier increase (12% overall), had a greater impact, especially on bus trips. Other factors (such as the economic recession then under way) may have influenced bus travel in this period.

TABLE 3

RECEIPTS GAIN AND RIDERSHIP LOSS FOR 1981-86 ELASTICITY ESTIMATES

DATE	FARES INCREASE	UNLINKED TRIP LOSS			RECEIPTS GAIN	RECEIPTS / PRICE RATIO
		TOTAL	BUS	RAIL		
January 1981	30%	-5%	-6%	-1%	19%	0.63
July 1981	12%	-7%	-8%	-2%	8%	0.66
February 1986	18%	-5%	-5%	-5%	11%	0.65

TABLE 4

ESTIMATED VALUES OF 1981-86 FARES ELASTICITY FROM CTA RIDERSHIP DATA

DATE OF FARE INCREASE	AVERAGE FARES INCREASE	FARES ELASTICITY		
		BUS	RAIL	SYSTEM
Jan. 1981	30%	0.20	0.03	0.17
July 1981	12%	0.66	0.16	0.59
Feb. 1986	18%	0.33	0.28	0.27
AVERAGE FOR ALL INCREASES:		0.40	0.14	0.34

- In 1986 the effect was more even, with an overall elasticity of -0.27. However, a higher proportion of rail journeys was lost due to the larger price increase for rail and no relief on pass prices. No further discounting of pass prices offered a neutral alternative to higher cash fares. While pass sales and usage did increase significantly, this was also attributed to the accompanying major change in transfer regulations.

Over the whole 1981-1986 period, on average the implied elasticity for all modes and fare payment methods was -0.34, close to the typical value for transit riders in developed countries in the West.

- Rail users were less sensitive to price changes than were bus users; probably for the combined reasons experienced elsewhere of longer journey length and greater orientation to work travel.

2.4 Comparison With 1981-1986 CBD Cordon Counts

To partially validate these estimates of fare elasticity, data extracted from 1981 and 1986 CBD Cordon counts were analyzed (Table 5).

TABLE 5

REDUCTION IN CBD TRAFFIC: CTA LOOP CORDON COUNTS AND SYSTEM-WIDE RIDERSHIP DATA

DATE/SOURCE	ALL DAY BUS	ALL DAY RAIL	PEAK HOURS BUS	PEAK HOURS RAIL
1981 - CORDON	- 3%	- 3%	- 2%	- 2%
1981 - RIDERSHIP	-15%*	- 3%*		
1986 - CORDON	- 7%	- 7%	- 7%	- 4%
1986 - RIDERSHIP	- 5%*	- 7%*		

*Note: These figures are from CTA Ridership data

There was a good degree of consistency between the two data sources--- CBD Cordon crossings (CTA riders) and system-wide CTA ridership. However, for bus journeys following the 1981 fare increase, CTA ridership data suggested a 15% loss of unlinked trips compared to a Cordon count loss of 3%.

- Radial bus journeys were much less sensitive to the 1981 fare increase. There may also have been a reduction in the average number of rides per journey in 1986, and if radial bus journeys are assumed to have a higher proportion of single-ride journeys, this would help explain the lack of comparable bus data contrasts in 1986.

- These results also suggest that off-peak journeys were on average about 50% to 75% more sensitive to fare increase than peak journeys (with the exception of bus in 1986, which exhibited no difference between peak and off-peak).

3. STATED PREFERENCE SURVEY RESULTS

Methods for estimating fare elasticity may be conveniently divided into three groups:

a) Time Series Analysis: variation in fares and demand over time.

b) Cross-sectional Analysis: variation in fares and demand over a geographical area, for a given point in time; and

c) Stated Preference Analysis: response to variation in fares in hypothetical situations, as stated by individuals.

Methods (a) and (b) are based on revealed preference data: how people actually did respond to fare changes. The analysis presented above of recent CTA fare increase experience represents a time series analysis.

3.1 1987 Stated Preference Survey Strategy

It was recognized from the outset of the study that existing data sources alone would not offer an adequate basis for estimating CTA ridership response to fare structure changes. Whereas some analysis of CTA ridership had already been undertaken to derive values of fare elasticity following previous fare increases, these data were inadequate with regard to significantly different fare structures.

As the study was concerned with the demand effects of a full range of fare structures, variation in fare elasticity among different market segments needed to be estimated. Additional data were collected using two consumer preference surveys. The most appropriate survey method was based on stated preference trade-off techniques. This allowed the level of disaggregation required to estimate the differential effects of the anticipated fare options, without involving a large and costly data collection exercise.

A key element of stated preference questionnaire design involved "experiments" which invited the respondent to express his or her preference, on a pair-wise basis, between specific service features of transit and alternative travel modes. A series of questions were structured that pair different service variables, set at different service levels, for both transit and auto, such that the respondent then expresses his/her mode preference. Several different fare levels were tested in this way.

For example, respondents were asked to state their preference for travelling to work by car or transit if: transit fare per month was $70 and the transit journey 10 minutes longer than by car, or automobile fuel cost $1.80 per gallon and 9 minutes were spent parking and walking to the office. With a sufficient series of such questions, it was possible to statistically determine the relative sensitivity or importance attached to each level of service factor, deriving average sensitivities for specific market segments.

3.2 Summary of Survey Methodology

An initial pilot survey was carried out on CTA Bus Route 94 to establish the transport alternatives available to CTA riders. The main survey then adopted two different survey methodologies:

- For journeys to work, a mail-back self-completion card survey was distributed at places of work to both CTA and non-CTA users.

- For non-work journeys, an interview survey was carried out at activity centers (such as shopping malls) attracting journeys for all purposes except work, by all modes of travel including walk.

Both survey methods were developed by extensive piloting, in which problems with data collection and questionnaire comprehension were eliminated as far as possible.

- The data from the pilot surveys were analyzed to ensure that the data collected would be adequate to meet the requirements of the study.

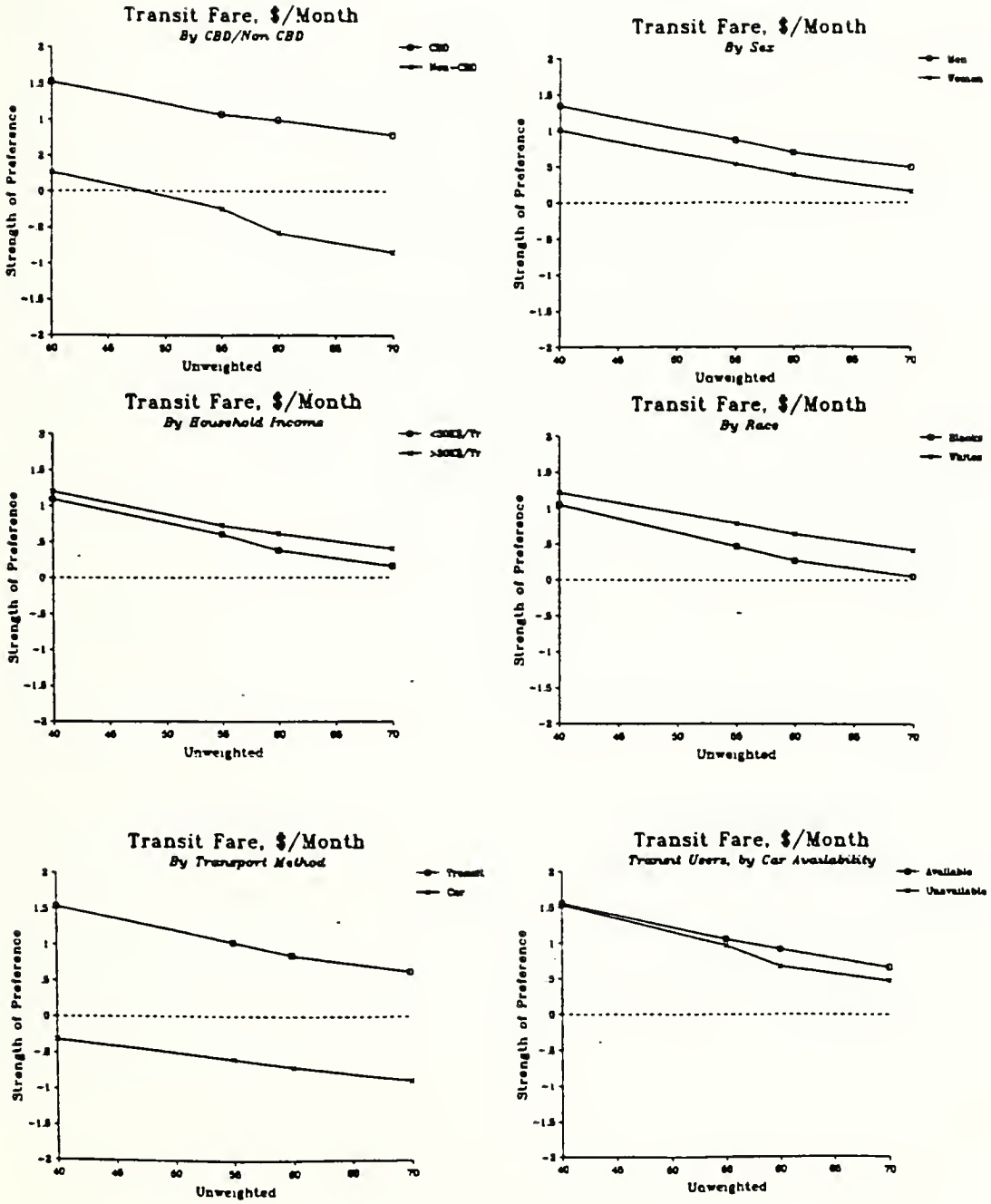
- During the place of work survey, 6,000 questionnaires were distributed of which 1,100 were returned. 25 employment centers were surveyed throughout the CTA service area.

A variety of methods of survey data analysis were employed, using primarily the SPSS statistical software package and ALOGIT. The analysis derived parameter estimates corresponding to the effect of fare variation on modal choice, for each of several market segments. These fare parameters were then used in conjunction with regional travel data (1979 CTA Origin-Destination Survey, 1980 Census Journey to Work Data) to formulate a demand model designed to estimated the demand effects of the fare structure options.

3.3 Journey-to-Work Fare Sensitivities

A market-segmented analysis showed the relationship between strength of modal preference and transit fare, for journey-to-work survey respondents (Figure 2). The strength of preference scale corresponds to relative survey ratings of transit. The relative changes with regard to increased monthly transit fare, rather than absolute rating values, are of interest.

Figure 2
STRENGTH OF MODE PREFERENCE
VS. TRANSIT FARE: WORK TRAVELERS



- o A comparison of travelers to the CBD and non-CBD shows a greater sensitivity to fare amongst the latter group, and higher absolute preference for auto: possibly a reflection of the radial nature of the transit network.

- o The non-CBD relationship exhibited some non-linearity; an S-shaped relationship may be more appropriate.

- o Men and women had similar strength of preferences with respect to transit fare. Women, however, had a somewhat higher absolute preference for car.

- o Household income had relatively little effect on either change in preference or absolute preference.

- o Poorer travelers appeared marginally more fare sensitive and had less absolute preference towards transit.

- With the generally lower-income profile of the black population, it was not surprising that the high and low income differences were also reflected in racial market segmentation.

- o The higher level of absolute preference towards auto amongst black and low-income respondents may reflect their higher perception of the status value of car travel.

The most marked differences were apparent when response is disaggregated by travel mode use.

- o Travelers had a strong preference for the mode they actually use.

- o Car users apeared marginally less fare-sensitive than transit users.

- o The final comparison, between respondents with and without an auto available, reveals little difference. Those who do not have a car available had a slightly stronger preference for car travel.

Transit fare was estimated to have the highest elasticity among the travel time and cost variables investigated. For the preferred statistical analysis model, this elasticity was estimated to be -.67 (unweighted). A 10% increase in transit fare on the mean fare of $56.25 per month in the Stated Preference survey design would induce a 6 - 7% reduction in transit market share. The other monetary factors, gas price and parking costs, were estimated to have considerably lower elasticities of .12 and .28 respectively (unweighted). The time factors for unweighted observations showed that transit walk/wait and travel time difference were estimated to have roughly equivalent elasticities of around -.05; parking time had the lowest elasticitiy (-.02).

3.4 Non-Work Journey Fare Sensitivities

Market segment mean score graphs for transit fare sensitivities were plotted for non-work travel survey respondents in a series of eight graphs (Figures 3 and 4), one for each of the following segmentations of response:

- Stated preference experiment (reflects type of survey choices: car, walk, no travel);
- Transport method (transit, car, walk);
- Car availability for transit users (available, unavailable);
- Race (whites, blacks, others);
- Destination (CBD, non-CBD);
- Sex (males, females);
- Household Income (<$30,000, >$30,000); and
- Age (under 18, 18-65, Over 65).

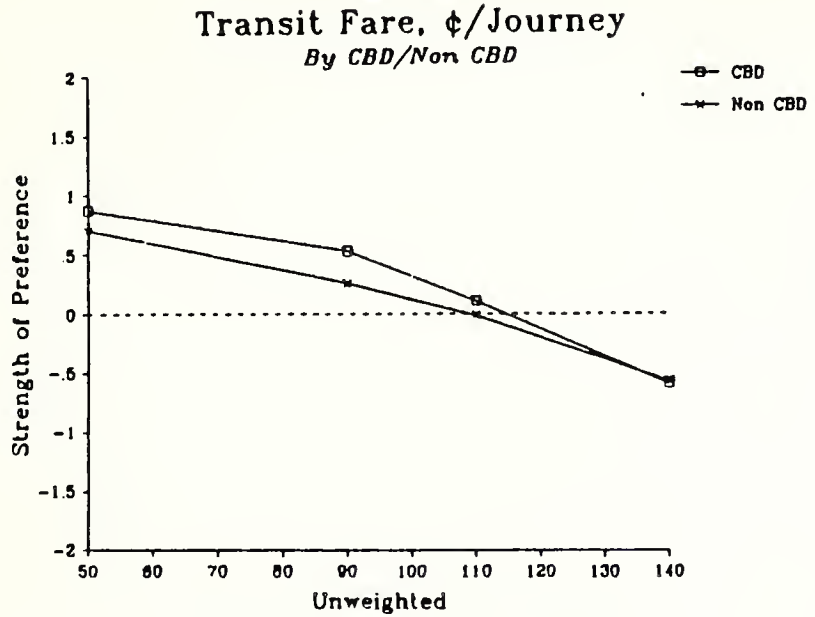
The key findings were:

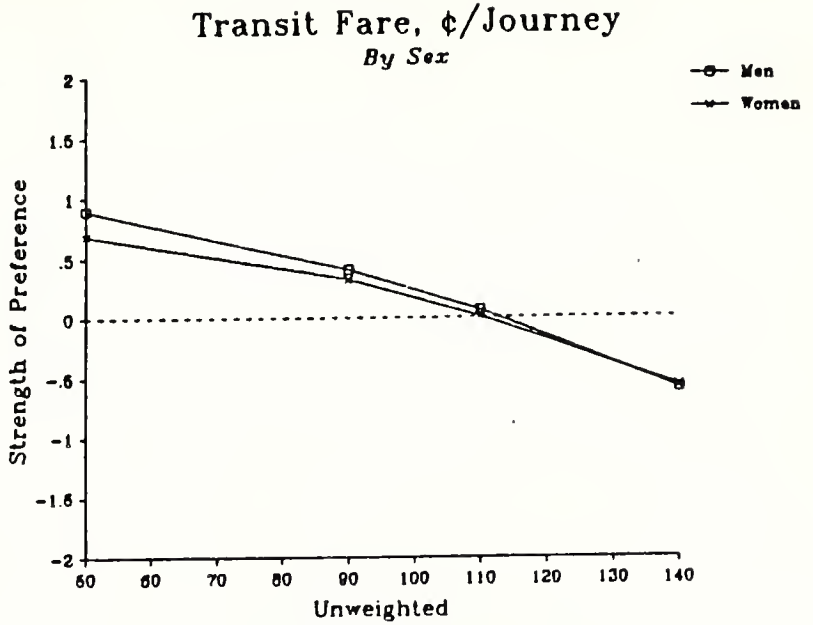
- A strong preference towards transit by respondents to the transit- not travel stated preference experiment, but a less noticeable difference in sensitivity to transit fare.
- Correlation of mode preference and current travel mode used:
  - Transit users preferred transit;
  - Non-transit users preferred their current mode (car or walk)

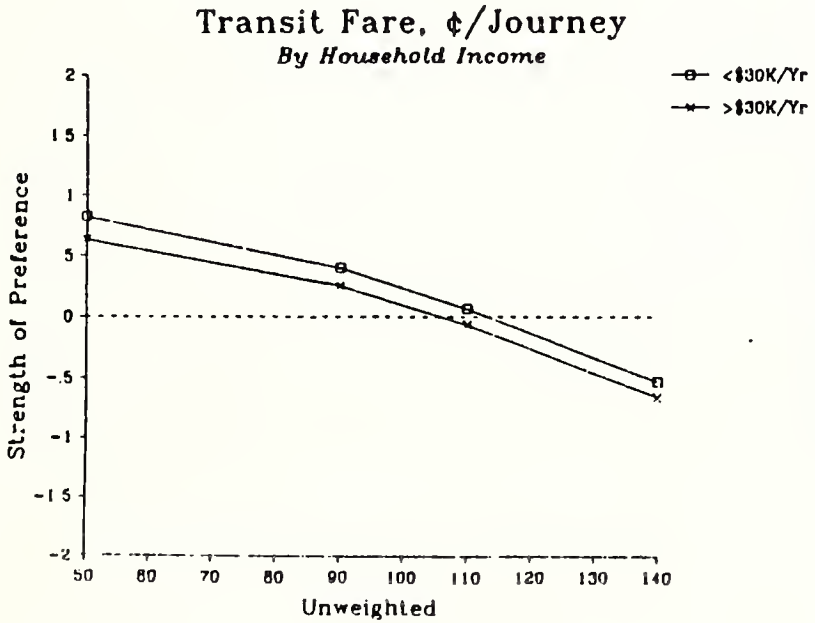
The sensitivity to transit fare was similar across most market differentiations:

- Car availability (transit users only), race, and age group had little effect on either the underlying mode preference or sensitivity to transit fare.
- Travelers to the CBD showed a slightly greater preference for transit, and were more sensitive to changes in transit fare than travelers to non-CBD destinations.
- Men showed a slightly greater preference for transit and a slightly greater sensitivity to changes in transit fare.
- Respondents from households of income less than $30,000/year showed a greater underlying preference towards transit, but had a similar sensitivity to changes in transit fare, similar to respondents from households of income greater than $30,000/year.

Figure 3
STRENGTH OF MODE PREFERENCE
VS. TRANSIT FARE: NON-WORK TRAVELERS







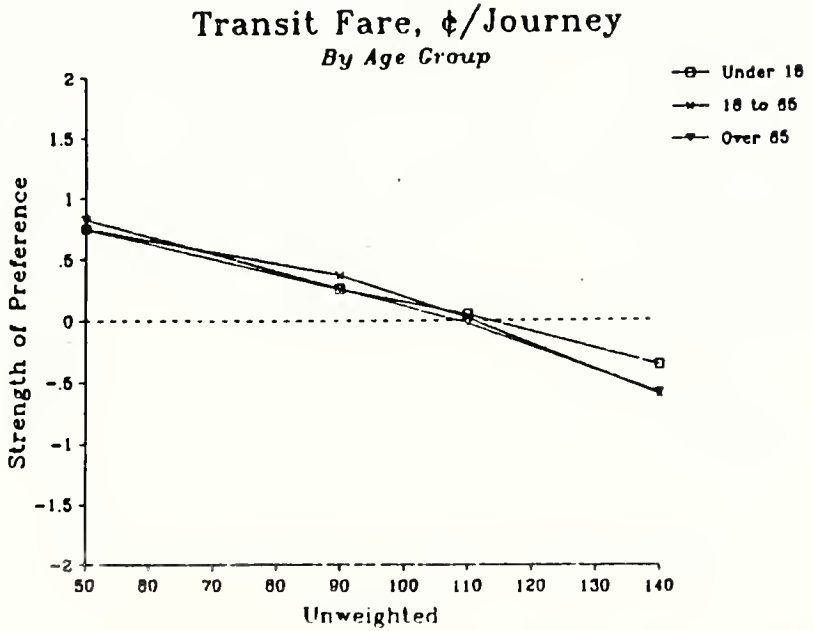
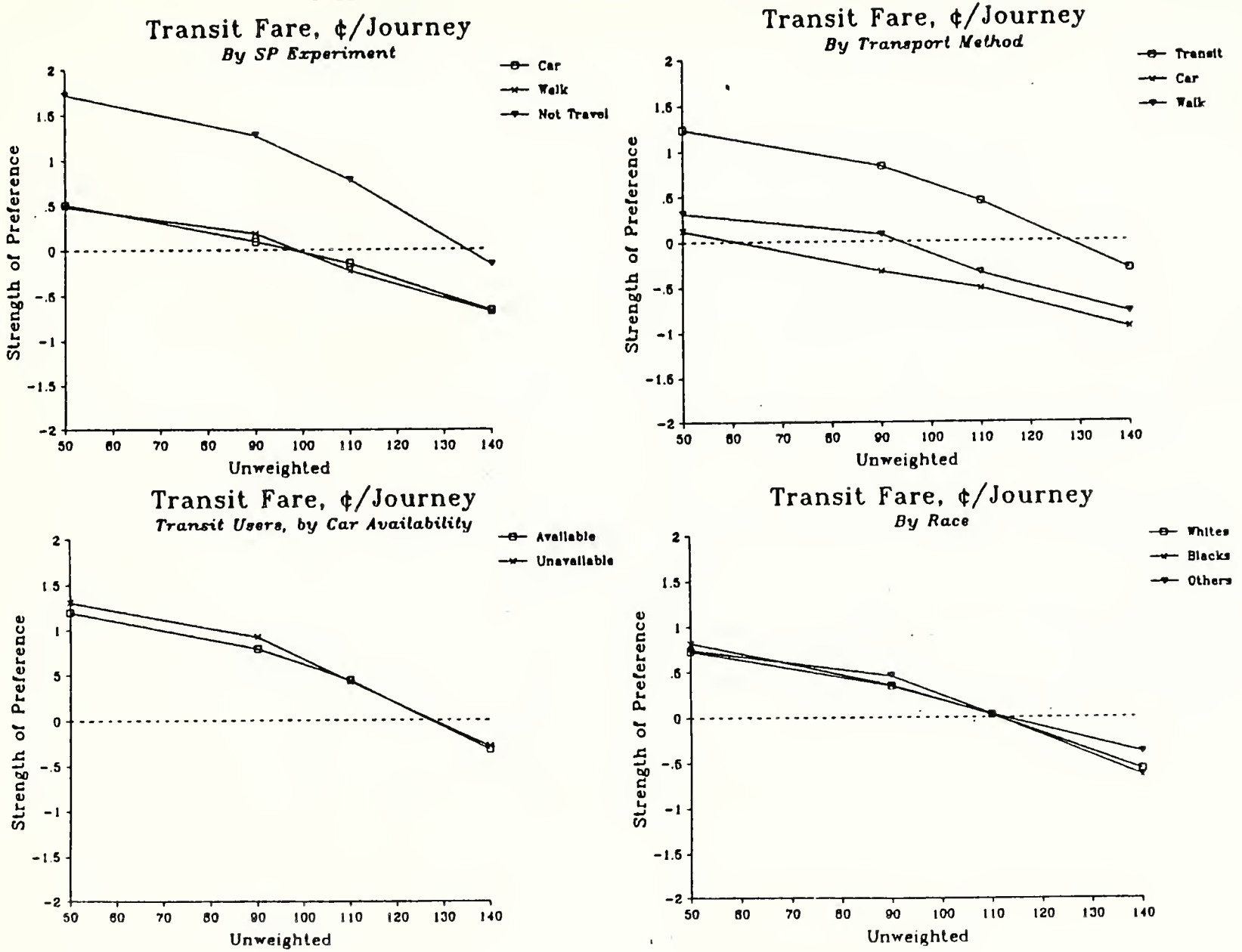


Figure 4
STRENGTH OF MODE PREFERENCE
VS. TRANSIT FARE: NON-WORK TRAVELERS



As with journey-to-work travelers, non-work travelers also displayed the highest relative elasticity for transit fare, in comparison to non-transit walk time, transit wait time, and parking time. For the preferred statistical analysis model, this elasticity was estimated to be -.79 (unweighted). Non-transit walk time and transit wait time also had relatively high unweighted elasticities of -.64 and -.58, respectively. These higher sensitivities were generally to be expected for the more discretionary nature of non-work travel. The high level of availability of travel alternatives also contributed to these results. A parking time elasticity of -.18 (unweighted) was also derived.

3.5 Synthesis of Market Segment Elasticities

To compare the values of fare parameters derived from the survey work with the values of fare elasticity derived from recent CTA fare increase experience, the parameters are represented as elasticities using 1987 base mode shares.

- The average value for fare elasticity derived directly from the survey results was -Ø.62 for all day; (-Ø.38 for the peak and -Ø.82 for the off-peak).

- Given that these values are considerably higher than would normally be expected, various explanations were explored.

  - On examining the 1979-198Ø regional journey data, there was a marked discrepancy between the proportion of riders who came from car available housholds (77%) and the proportion who stated that a car was actually available for the journey (36%).

  - This implied that the stated preference questionnaire encouraged individuals to respond assuming a car would be available for their journey, whereas in practice this may not always have been the case.

In translating the mode split model from the individual to the aggregate level, car availability for a journey was used to reinterpret the base probability of traveling by car.

- The values of fares elasticity implied by changes in transit share at the aggregate level were therefore much lower (Table 6).

TABLE 6

VALUE OF FARES ELASTICITY DERIVED FROM STATED PREFERENCE SURVEY DATA

MARKET SEGMENT	PEAK	OFF-PEAK
Central Area	Ø.26	Ø.39
Radial	Ø.11-Ø.13	Ø.36-Ø.39
Local	Ø.19-Ø.24	Ø.41-Ø.44
< 2 Miles	Ø.29	Ø.49
Overall	Ø.19	Ø.44
Average all Day	Ø.33	

Note: The ranges quoted above for Radial and Local market segments correspond to a further disaggregation into inner and outer zones.

Relative and absolute (adjusted) elasticity values among the various market segments revealed that:

- o Off-peak elasticity is more than twice peak-hour elasticity.
- o Radial markets have a lower fare elaticity than local markets; this difference is much more pronounced in the peak.
- o Journeys of less than 2 miles exhibit a higher level of sensitivity to fare change than journeys greater than 2 miles.

4. CONCLUSIONS

With an overall average system-wide fare elasticity of -.33, indicating that for every 1% increase in average fare (across all fare payment categories), a .33% decrease in overall system ridership is to be expected, it was possible to derive a series of disaggregated fare elasticities by market segment. Some of these elasticities were higher than this average, while others were lower. For example, it was found that peak-hour travelers, rapid rail transit riders, and radial transit riders are less sensitive to fare increases. Consequently, any restructuring of CTA fares that placed a relatively higher fare on these market segments would correspondingly experience a lower loss in ridership.

In contrast, off-peak travelers, bus riders, and local, short-trip (including within Central Area) travelers are more sensitive to fare increases. Any revision in fare structure that charged these market segments relatively less in increased fares would correspondingly see relatively less ridership loss.

Analysis of 3 CTA fare adjustments since 1981 indicated a degree of inconsistency in ridership response to fare increases, reflecting as well the effect of other service and fare changes (such as the significant tightening of transfer regulations in 1986). This variability over time in fare elasticities, on a bus versus rail as well as system-wide level, should be expected to carry over to the market segment elasticities derived from stated preference surveys. While the survey results derived were generally consistent with the literature, future surveys should be expected to show somewhat different outcomes, perhaps reflecting changes in the economy, travel habits, relative congestion levels, etc.

Two areas of fare sensitivity in particular merit further analysis. These include:

1. Pass-cash trade-offs: Initial investigation showed a clear tendency for CTA riders to respond reasonably to differences in the relative increase in pass prices and cash fares. When pass prices went up less than cash fares, a corresponding shift to pass purchase and usage was observed. However, when 1986 changes in transfer regulations complicated the task of analyzing fare sensitivities, an unexpectedly high shift to pass usage occurred, though there was still a corresponding relationship to increases in transfer prices. Initial attempts made in this project to structure a pass-cash trade-off model merit further analysis, as a part of exploring the expansion of prepayment fare options.

2. CTA stated preference survey results showed little sensitivity to distance-based fares. In other words, survey respondents were largely unwilling to pay for transit on a per-mile basis (beyond a 2-mile journey length). However, because distance-based fare structures have been fairly well accepted in regions where implemented, this survey result may reflect consumer inertia, or at least a response that could change over time. However, because of the high capital costs associated with distance-based fare structures, this conservative survey result was directly employed in the broader analysis, and was a major factor in the less promising prospects for this fare structure. These results also merit further investigation.

1987 TRIP DIARY SURVEY: PASS VS. CASH-FARE

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ANALYSIS OF CTA MARKETS: RIDERSHIP HABITS AND CHARACTERISTICS OF PASS USERS AND CASH FARE RIDERS

ABSTRACT

Riders in CTA's two broadest markets--pass users and cash-fare payers--were included in a 1987 Trip Diary Survey. The survey instrument, developed by LTI Consultants, Inc., collected one-day trip sample diaries from both groups of CTA riders, which revealed the demographic and travel patterns of riders. The study design yielded a representative sample of riders; each fare type was drawn separately, using pass distribution centers as well as on-vehicle survey administration.

The analysis emphasized the differences in socio- economic characteristics, travel patterns, trip purposes, and pass purchasing characteristics. Pass users took more rides on CTA each day than did cash-fare riders, and were more likely to make work trips. Surprisingly, pass user incomes were lower than those of cash-fare riders, indicating the broad appeal of the monthly and 14-Day passes.

CTA riders were profiled by household income, persons/household, autos available, race, age, fare-payment method, time-of-day of travel, and trip purpose. This representative sample confirmed the broad range of people who choose to ride CTA. Two-thirds of CTA riders came from a household with a vehicle available; average rider age was 27.2-32.5 years, and average household size was 2.83-3.23.

INTRODUCTION

In July and August of 1987, the Market Analysis and Research section within the Department of Strategic Planning conducted two surveys of two groups of riders on the CTA's bus and rail system with assistance from LTI Consultants, Inc. Two separate questionnaires were developed, one surveying the use of CTA's pre-paid, unlimited ride, monthly and 14-day system passes; the other questioning a sample of cash-fare payers and token users. (Jones, 1988). Both surveys were similar, gathering information about travel patterns, socio-economic characteristics, pass purchase habits, monetary costs of traveling on the CTA, and preferences for alternative types of passes.

Since 1983, the share of unlinked rides paid by pass rose 60%, from 20% to 32% of unlinked rides. CTA experienced an increase of 17% in pass ridership after the 1986 fare changes were implemented (comparing January 1986 to January 1987), while the number of cash-fare-paying riders fell 15%.

Though differences may exist between pass-users and cash-fare payers in terms of trip patterns, ridership habits, personal travel costs, and socio-economic characteristics, CTA had not previously established any clear method for analyzing the

two groups of riders according to these factors. Survey respondents were asked to report all the trips they made on the day before they received the survey form. The CTA pass structure as it exists now has not been targeted to serve distinct sub-markets of pass buyers, except to offer both monthly and 14-day instruments. The surveys provided the opportunity to learn who has been using CTA passes, and how and when they are used. Further comparisons could be made against cash-fare riders, shedding light on questions of whether to introduce other fare media.

2. RESULTS

All returns were weighted according to proportions set by the number of surveys sent to each pass distribution center for the pass survey, or the scale of cash fare payers at each of the stations or bus routes. This provided for analysis of a representative sample of CTA ridership. Usable returns for the pass-user survey numbered 1123; total cash-fare payer surveys returned were 1375. Of those returned, 723 pass-user surveys and 696 cash-fare rider surveys were returned with a usable trip diary log.

2.1 DEMOGRAPHIC CHARACTERISTICS

Respondents to the pass survey, when compared on average to the cash survey respondents, were 5.3 years older, had approximately $4,500 less in annual income, lived in smaller households, owned fewer private vehicles, and were (slightly) more likely to be female.

Highlights

The socio-economic characteristics of riders are based on the pass-user and cash-fare payer surveys (Table 1). The larger sample returns of 1,131 pass surveys and 1,375 cash surveys provided these profiles of pass and cash riders.

TABLE 1. PROFILE OF CTA RIDERS BY FARE PAYMENT METHOD

Characteristic	Pass Users	Cash-Fare Paying Riders
Gender	65% (Female)	61% (Female)
Age (median)	27.2 years*	32.5 years*
Household Income		
(Median)	$17,121	$22,100
(Mean)	$20,600*	$25,100*
Household Size (Mean)	2.83*	3.23*
Vehicles available to household	0.87*	1.12*
% with at least one vehicle	58.7*	70.3*
Race		
Black	47.3	42.6
White	40.6	46.1
Hispanic	6.7	6.5
Asian	3.6	3.5
American Indian	0.7	0.3
Other	1.1	1.0

*Indicates significant difference between pass-users and cash-fare riders on this travel measure, at 95% confidence level.

Age and Sex of Rider

The age distributions for each survey showed similar percentages for the age ranges 12 to 17, 18 to 24, and 35-44. Cash-fare payers were more likely to be younger than 45 years old than pass-users. Cash-fare payers had 32.8% in the 25 to 34 age category; only 24.4% of the pass-users were in the same category (Table 2).

Table 2. Age of Riders by Fare Payment Method (% of Riders)

Fare Payment Method	Rider Age 12-17	18-24	25-34	35-44	45-64	65+	Total
Cash-fare payers	3.5	19.3	32.8	20.9	18.6	4.8	100.0
Pass-users	2.5	8.1	24.4	20.7	24.8	9.5	100.0

The older pass-users were mostly in households with 1 or 2 people. An interesting difference in household size focuses on one-person households: 9.6% more pass-users lived in single-person households than did cash-fare payers. Also, 30.2% of the pass-users lived in households of 4 or more persons while 40.1% of cash-fare payers lived in the same-sized households. Thus the difference in household size between pass-users and cash-fare riders arose from both factors--pass users had a greater share of one-person households and a smaller share of larger households (4 or more persons).

Among all women riders, pass-users were 9.7% more likely to live in single-person households than were cash-paying riders. Among all men riders, 8.7% more male pass-users than male cash-fare payers lived in single-person households, similar to the pattern for women.

Income and Auto Availability

Comparing vehicle availability and income of pass-using vs. cash-fare riders, the correlation between these two variables was not as high as often believed. The cash-fare payers had a positive correlation of 0.45 between vehicles available and income; pass users had a positive correlation of 0.39. These low correlations were consistent with the generally high level of auto availability among all CTA rider households (two-thirds had at least one).

Among cash-fare payers, 15.4% were carless and low-income (less than $10,000 in household income), while 8.8% had 2 or more vehicles and income over $40,000. By contrast, 11.8% of pass-users were carless and low-income; and only 4.2% had 2 or more vehicles and more than $40,000 in income. Thus, cash-fare riders were more likely to be in the extremes of these two indicators.

Low-income (under $10,000) monthly full-fare pass-users were more likely to be female (71.7%). Proportions among the income ranges and vehicle ownership were more spread out for the predominantly used cash-fare types.

Fare Type

The sample distribution of fare types and pass types used by respondents is shown in Table 3. Most pass-users (61.6%) had a monthly full-fare pass, while 24.9% had 14-day full-fare passes. The distribution among cash-fare types was more even, except for the $.90 bus fare.

In 1987, 68% of unlinked rides were paid by cash or transfer, while 32% were paid by pass. In the month of August (8th financial period), 35% used pass to board a vehicle (Full count boardings).

TABLE 3. PASS AND FARE TYPE DISTRIBUTION

Type of Pass	%	Cash Fare Type	%
Monthly Full-Fare	59.4	$ .90	8.6
Monthly Reduced Fare	12.5	$1.15	26.1
QuikPass Full	2.2	$1.00	29.6
14-Day Full Fare	24.9	$1.25	28.5
14-Day Reduced Fare	0.8	$ .40	1.2
		$ .55	3.4
		$ .50	0.7
		$ .60	2.0
	100.0		100.0

2.2 Preference for New Types of Passes

Riders were queried as to their preference for alternative passes to the present monthly pass (Table 4). The questions were asked of both types of riders. A majority (71.8%) of cash-payers and 90.4% of pass-users would not consider buying a cheaper pass valid only during off-peak hours. However, that means 28% of cash-fare riders, a sizeable market, would consider an off-peak only pass.

Most (70.5%) cash payers and 80.4% of pass-users rejected a cheaper pass valid only on buses. Viewed affirmatively, nearly 30% of cash-fare riders would consider a bus-only pass. Two-thirds of each sample preferred QuikPass to the present monthly pass. QuikPass was described as an automated pass providing quick systemwide access, as compared to the present flash pass.

Only 27.9% of pass-users would buy the peak-hour-only pass, but 69.2% of cash payers would prefer to buy such a pass. This indicates that most cash-fare riders are peak-only riders.

TABLE 4. PREFERENCE FOR ALTERNATIVE PASS

(% Preferring Alternative Over Present Monthly Pass)

Alternative Pass	Pass-User	Cash-Fare
1. Cheaper peak hour pass	27.9	69.2
2. Cheaper off-peak hour pass	9.6	28.2
3. Cheaper bus-only pass	19.6	29.5
4. QuikPass	65.6	68.3

2.3 Travel Patterns

Analysis of the diary log provided many descriptions of ridership trip-making patterns. The following analysis is based on the means for each group of riders (pass or cash-fare). Any differences noted in this discussion were statistically significant differences between the means, at 95% confidence.

Travel characteristics are described by using the "journey" to describe linked trips (e.g., a journey from home to work) and "leg" to describe unlinked trips. Legs, specific components of a journey, relate to CTA's ridership statistics, which are expressed as unlinked trips, counted each time a rider boards a CTA vehicle. The travel characteristics of CTA riders are presented in terms of the daily mean for pass-users and cash-fare riders on two dozen measures of trip-making patterns.

Significant differences were observed in the analysis of daily travel patterns of pass-users and cash-fare payers. The travel patterns of these two rider markets varied with respect to trip frequency and how they used CTA bus and rail vehicles to reach their destinations.

Pass-users made 2.62 journeys per day and cash-payers made 2.18 trips per day, 17% less than pass-users (Table 5). Pass-users made 1.9 legs per journey and cash-payers only 1.6 legs per journey, 16% fewer journey legs than pass-users (but not statistically significant at 95% confidence). Counting all the journeys an average respondent for each survey made in one day, a pass-user made almost one extra leg each day: 4.45 legs/day for pass-users and 3.51 legs/day for cash-fare payers, 21% less than pass-users.

TABLE 5. DAILY JOURNEYS AND LEGS ON CTA BY FARE PAYMENT METHOD

Travel Measure	Pass-Users	Cash-Fare Riders
Journeys/Day	2.62*	2.18*
Legs/Day	4.57*	3.51*
Average Legs/Journey	1.94	1.64

*Indicates significant difference between pass-users and cash-fare riders on this travel measure, at 95% confidence.

Transit Mode Used

Pass-users used the bus system more than cash-payers did. Of all pass-users, as seen in Table 6, 58.9% made at least one journey composed entirely of bus legs. Only 43.8% of cash-fare payers did the same.

TABLE 6. FREQUENCY OF DAILY JOURNEYS MADE BY BUS-ONLY

No. of Bus-Only Journeys	Pass-User %	Pass-User Cum %	Cash-Fare Rider %	Cash-Fare Rider Cum %
0	41.1	41.1	56.2	56.2
1	13.9	55.0	7.4	63.7
2	30.7	85.8	33.6	97.3
3	8.5	94.2	1.7	99.0
4	3.7	97.9	0.6	99.7
5	1.8	99.7	0.1	99.7
6	0.1	99.8	0.1	99.7
7	0.2	100.0	0.3	100.0

More than a third (37.5%) of pass-users and 32% cash-fare payers made no rail journeys. The mean number of legs taken by bus for pass-users was 2.8; cash-fare payers made 2.0 bus rides (39% less). Pass-users and cash-fare payers made an equal number of rail legs, Table 7.

A bus journey was defined as one consisting of only bus links or legs (Table 7). Any journey with at least one rail leg was considered a rail journey. Pass-users made, on average, 1.3 bus journeys, significantly more than the 0.8 bus journeys made by cash-fare riders. Cash-fare payers made 1.3 rail journeys, not significantly different from the 1.2 rail journeys made daily by pass-users.

TABLE 7. DAILY TRAVEL ON CTA BY MODE AND FARE PAYMENT METHOD

CTA Mode	Pass-User	Cash-Fare Rider
Journeys		
Made only aboard buses	1.31*	0.84*
With at least one rail leg	1.25	1.33
Legs		
On bus	2.82*	1.96*
On rail	1.51	1.55

*Indicates significant difference between pass-users and cash-fare riders on this travel measure, at 95% confidence.

Purpose of Travel

Journeys made by each group of users were segmented by travel purpose. Non-work, home-based work, and non-home-based work journeys were measured. Nearly all (95.8%) pass-users used

their pass to make home-based work journeys. Only 83.9% of cash-fare payers indicated that they made at least one home-based work journey.

Pass-users also were more likely to make non-home-based work journeys than were cash-fare payers: 21.7% of pass-users vs. 12.2% of cash-fare payers. (Non-home-based work journeys either start or end at the workplace, but have as the other end either shopping or other, not specified, purpose.)

It was evident that pass-users took advantage of the pass by making more (unlinked) trips from work (e.g., out to lunch, or to night school) than did cash-fare riders. By contrast, pass-users made no more non-work trips on the survey day than did cash-fare riders.

Pass-users made more journeys to work than did cash-fare riders. The average exceeded two, reflecting both the greater likelihood of a pass-user making a home-to-work journey and of making non-home-based work journeys. Pass-users had a decided preference for bus-only journeys, perhaps reflecting CTA's 1987 fare structure, which priced the pass at 40 x (bus fare + transfer). Riders using only one rail vehicle for each home/work journey, and making only work journeys on CTA, would be paying more than cash fares paid each day if a pass were purchased.

The pattern of pass-users relying more on bus, cash-fare riders more on rail, held for non-work journeys as well. Another aspect of the pass besides pricing probably affected rail-riders use of passes: flash passes must be viewed by the ticket agent, where long lines can form during peak boarding times. Riders with four quarters, or a token and $.10 in 1987, could use coin-operated turnstiles to avoid those queues at busy stations. On the bus system, flash passes allowed boarding at least as quickly as with cash, and more conveniently.

The importance of this convenience difference was highlighted in a survey of rail riders using QuikPasses in early 1987. In that group of riders, 25% used the pass for convenience, not to save money, because the QuikPass allowed faster boarding through automated pass-reading turnstiles installed at high traffic stations.

TABLE 8. DAILY JOURNEYS ON CTA BY TRIP PURPOSE, MODE AND FARE PAYMENT METHOD
(Journeys/Day)

Trip Purpose and CTA Mode[a]	Pass-User	Cash-Fare Rider
Work	2.17*	1.78*
Bus	1.03*	0.68*
Rail	1.14	1.09
Home-Based	1.85*	1.61*
Bus	0.86*	0.60*
Rail	0.98	1.01
Non-Home Based	0.32*	0.17*
Bus	0.16*	0.08*
Rail	0.16*	0.08*
Non-Work	0.40	0.39
Bus	0.29*	0.16*
Rail	0.11	0.23

*Indicates significant difference between pass-users and cash-fare riders on this travel measure, at 95% confidence.

[a]If either the origin or destination was work, the journey was classed as work; if neither, then the trip was non-work. Journey was classed as rail if it included at least one rail leg.

Time-of-Day Travel

Another measure used to compare the two groups of CTA riders was ridership during peak hours and off-peak hours (Table 10). Pass-users took more journey legs in each period of the day than did cash-fare riders. In the peak hours, pass-users made 17% more journey legs-2.9 vs. 2.4 journey legs made by cash-payers. In the off-peak, pass-users made 21% more journey legs-1.4 vs. 1.1 legs made by cash-payers, but the difference was not statistically significant.

TABLE 10. DAILY RIDES ON CTA BY TIME OF DAY AND FARE PAYMENT METHOD

(Legs/Day)

Time of Day[a]	Pass-User	Cash-Fare Rider
Peak	3.00*	2.36*
Off-Peak	1.40	1.10

[a]Leg (unlinked trip) began 0545-0900 or 1445-1800 hours for peak; outside those hours, leg was off-peak.

*Indicates significant difference between pass-users and cash-fare riders on this travel measure, at 95% confidence.

Trip Composition

The pass was promoted as a replacement for CTA's unlimited re-use (in a two-hour period) transfer, when the fare structure was altered in 1986. Since February, 1986, transfers have been limited to two uses,and cannot be used on the route of issuance--i.e., no round trips. (An exception was made for senior citizens and disabled riders in the off-peak). Riders have clearly responded to that re-structuring, as 75% of pass-users had at least one weekday journey using two or more vehicles, compared to only 57% of cash-fare riders. One-vehicle journeys were measured in 1983 and 1986, prior to the surveys presented in this report. In 1983, 56% of journeys used only one vehicle, and 58% in 1986.

It was clear from these surveys that there were two distinct travel patterns among riders. Though transferring to one or more vehicles to complete a journey was common, and encouraged, on CTA, 43% of cash-fare riders and 25% of pass-users made all their journeys on the survey day using only one CTA vehicle. Clearly this large group of riders viewed the fare structure quite differently than riders who routinely used two or more vehicles to complete a trip. Tokens were the only prepaid fare medium aimed at this former group. Because of the importance of this group, further surveys of token users are planned.

3. CONCLUSIONS

Data provided by the August 1987 surveys of CTA riders confirm that those riders using a monthly or 14-day pass have different travel patterns and demographic characteristics than cash-fare riders. Riders expressed preferences for other types of pre-paid fares media, supporting the development of passes for specific submarkets of CTA riders.

Reference

A. K. Jones and S. J. LaBelle, 1988, 1987 Trip Diary Survey: Pass vs. Cash-Fare, Chicago Transit Authority, Strategic Planning Report SP 88-03, May 1988.

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Evaluation of CTA Fare Structure Options

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EVALUATION OF CTA FARE STRUCTURE OPTIONS

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ABSTRACT

A recent assessment of fare structure options for the Chicago Transit Authority found three alternatives superior to the present structure. Six basic options, three of which represent alternative approaches to charging fares in relation to trip distance, were systematically compared according to ten evaluation criteria. The options are briefly described, while the ten criteria are examined in somewhat more detail.

Three criteria were of greatest importance: relative impact upon revenue generation and associated ridership loss, relative ridership impacts due to comparable average fares, and annualized capital-operating costs of implementation. Trade-offs among the different fare structure options in terms of these three criteria, as well as the remaining criteria, are discussed. The remaining criteria include: ease of implementation, reasonableness (public acceptability), revenue protection, reversibility (risk of capital investment), impact on disadvantaged ridership, simplicity, and management information generated.

The basic conclusion of the project was that options which introduce a peak/off-peak fare differential and a bus/rail fare differential rank considerably higher than distance-based options.

Increased prepayment of fares via passes and tickets would also provide a means of achieving many of the aims of an improved fare structure at CTA. The advantages and disadvantages of these three more promising fare structure options are outlined.

1. INTRODUCTION

The primary aim of the project, in generating basic fare structure options for evaluation, was to search for methods to maximize revenue and, if possible, ridership by applying different fare payment schemes. The study reviewed different methods of charging fares to identify:

- o Effects on Ridership
- o Effects on Revenue

The practicalities of various charging methods were also evaluated, in relation to the spatial configuration of CTA's bus and rail system, and geographic and temporal patterns of travel behavior. Basic travel market segments were identified to determine a range of alternative charging methods:

- o Peak/Off-Peak (for this study, it was assumed that journeys in the peak approximated work journeys)
- o Central Area/Non-Central Area
- o Distance

In addition, charging methods based on bus/rail transit modes and method of payment were evaluated. Although these were not treated as separate "markets", the additional scope these aspects provide for alternative charging methods enabled the formulation of a comprehensive range of fare structures.

2. FARE STRUCTURE OPTIONS

The five methods of charging fares were not themselves regarded as complete options. By estimating the ridership and revenue effects of each method separately, the subsequent effects of combination fare structure options (a blend of these different methods of charging) could be evaluated. This approach allowed the demand effects of the widest possible range of options to be estimated.

2.1 Peak/Off Peak

A time-based method of charging was considered because:

- o The work travel market, with generally a greater ability to pay for travel costs, can more easily be exploited by charging higher fares during the peak
- o There are strong operational arguments for encouraging increased off-peak ridership that can be served at marginal cost
- o Work journeys exhibit low fares elasticity
- o Work journeys face less attractive auto-highway options, with higher auto-operating and parking costs, as compared to non-work auto journeys

Peak traffic loadings determine fleet size and staff requirements, a strong argument in favor of charging higher fares in the peak, and encouraging greater off-peak travel where there is surplus capacity. In addition, peak-hour passengers benefit from higher service frequencies, although they suffer from overcrowding. Further, this method of charging is relatively simple to implement.

2.2 Central Area - Non Central Area

Analyses of transit market segmentation, based on an examination of existing Chicago travel data (1979 CTA Origin-Destination Survey and 1980 Census Journey to Work data) were also conducted. These analyses suggested that journeys to and from the Central Area would respond differently to transit fare changes compared to other journeys, and could be regarded as a separate market. This method of charging was assumed to be combined with distance-based charging and bus/rail fare differentials, to simplify the analysis.

2.3 Distance

Charging by distance was included for several reasons:

- Based on experience in other cities, fare elasticity was assumed to decrease with distance.
- Fares elasticity of long-distance trips to the Central Area may be low.
- The scope for generating additional revenue, particularly during peak periods and to the Central Area, may be high.
- The cost of providing transit services increases with distance.
- Charging accordingly is seen as equitable by passengers.

It is possible that revenue increases can be achieved with little adverse effect on ridership levels. The practical implications of charging by distance must be carefully handled; for revenue increases to be fully realized, burdensome administrative controls must be minimized.

2.4 Bus/Rail

In CTA's service area, charging different fares for bus and rail services was regarded not so much as setting fares for mode-specific markets, but as a straightforward means of charging both by distance and for Central Area destinations.

- Rail services are faster and provide good access to the Central Area compared to bus
- Rail passengers take longer journeys and are more likely to have Central Area destinations
- Rail journeys generally show a lower fares elasticity than bus, and therefore offer some potential for increasing revenue

However, care must be taken in approaching this type of differential charging; in Chicago a significant number of journeys (about 18%) include travel by both modes. Charging by mode could run counter to the CTA's responsibility for providing an integrated transit system; passengers should not be penalized for changing mode.

2.5 Method of Payment

Although this is quite different in nature from the other four charging methods, a review of prepayment methods was included because:

- The availability of a prepaid ticket can amount to an alternative fare structure
- An element of price discrimination is introduced for the same product

Two distinct kinds of prepaid ticket were considered: time-based and value-based.

- A value-based ticket is effectively a cash fare with a fixed level of discount, with a specified or limited number of trips allowed
- Time-based tickets (passes) allow unlimited travel (number of trips) within a specified time and geographic area.

For time-based prepaid tickets, the fare charged per journey decreases with increased frequency of travel; the marginal cost to the rider of additional travel is zero. Both types of prepaid ticket benefit riders and operators alike in terms of convenience and flexibility.

2.6 Overview

These five methods of charging provided a basis for formulating a range of fare structures by combining elements of each. Some options could involve all five methods of charging, as is the case in London.

- Each method was considered in isolation to estimate how it might contribute to achieving the revenue and ridership aims of evolving CTA fares policy. When options including several elements are evaluated, the effects of each may be confused.
- An upper limit for revenue/ridership possibilities was determined by evaluating the effects of charging to these limits from a demand point of view, unconstrained by the practical aspects involved in fare collection. This gave an indication of the extent to which it was worth developing an option.
- This oversimplification (examining each method in isolation) was balanced by the assumption of possible change in routing to better align with a particular fare structure, which allows recapture of some riders potentially lost by the new fares.
- To a large extent, the method of collecting and enforcing fares does not significantly influence demand.
- In considering the practical implications associated with the methods of charging, it was found that superior options appeared feasible by costing several alternatives/permutations.

The prime concern in formulating options was to include in the study a range of options that explored all reasonable demand effects.

2.7 Summary of Option Development

The following fare structure options were developed as essential components of the fare structure analysis. These options reflected the markets CTA serves, addressing the factors affecting transit demand.

1. Peak/Off-Peak Differential

2. Distance-Based Fares

   (a) Rail Zonal (ticket-based system involving three concentric zones, and fare related to number of zones traveled; all but 28 stations equipped with automated ticket processing equipment)

   (b) System Zonal (both bus and rail, with buses also equipped with ticket vending and ticket validating equipment)

   (c) Rail Graduated (fully automated ticket-based system, at all 143 rail stations, using stored-value tickets that decrement graduated fares reflecting the distance between each station pair)

3. Bus/Rail Differential

4. Prepayment

3. EVALUATION FRAMEWORK AND CRITERIA

A comprehensive set of criteria was established to provide a framework to incorporate all the goals and strategic choices identified. This evaluation framework was designed to address not only the broad corporate aims of the Transit Authority, but also the sub-goals identified by the Fare Policies Task Force and the Advanced Fare Controls Task Force.

3.1 Maximize Revenue While Minimizing Ridership Losses

Each fare structure option was assessed on: (a) its ability to raise additional revenue; and (b) its potential for generating slight ridership losses due to fare increase sensitivities. The first measure was taken as estimated total fares revenue increase, and ignored the revenue collection costs and capital costs associated with changing the fare structure. The second measure was estimated based on fares elasticities derived from work and non-work travel surveys conducted specifically for this project. The assessment was based on an average fares increase of ten per cent.

- All existing CTA fares were increased at a flat rate of 10% to provide the base against which the options were evaluated.

- For the individual fare structure options, fares were increased such that the overall average increase, across all fare categories, was ten per cent; certain fares were restructured in line with the nature of the option.

- For example, in the case of the peak/off-peak option, peak fares were increased by around twenty per cent while off-peak fares were unchanged.

This criterion (with two separate measures) assumed that the loss of ridership for the base was the maximum acceptable loss for the revenue gains achieved. The other options were then compared on the basis of the revenue they could generate against that maximum ridership loss.

The fare structure options were evaluated to measure the extent to which each achieved basic fare policy aims. Ten separate criteria were used in this evaluation: Maximize Revenue While Minimizing Ridership Loss; Maximize Ridership While Maintaining Existing Net Revenue; Ease of Implementation; Reasonableness (Public Acceptability); Revenue Protection; Cost; Reversibility (Risk); Equity of Fares; Simplicity; and Management Information.

3.2 Maximize Ridership While Maintaining Existing Net Revenue

As a counter-balance to Criterion 1, options were assessed by their ability to increase ridership, both in terms of journeys and passenger-miles, while maintaining the existing level of revenue. The relative value to be attached to journeys or passenger-miles was left to be decided outside the framework.

3.3 Ease of Implementation

The ease with which options could be implemented, and the staging necessary to allow a reasonable transition phase or phases, would be reflected in the costs and timing of expected benefits.

- o The effects of timescale were evaluated by the use of discounting.

- o A separate assessment to account for the complexities of each option was included.

3.5 Revenue Protection

The effects of changes to revenue protection procedures for each option were taken into account in estimating the change in fares revenue and operating costs. It became evident during discussions with CTA staff that improving revenue protection was an aim worth pursuing in its own right. Revenue protection was therefore adopted as a separate criterion. Options were evaluated in qualitative terms on the basis of scope and likelihood of improvement in revenue protection.

3.6 Costs

The costs of each option were estimated by including a first-cut assessment of the capital costs of fare equipment and station modification, and any revenue collection costs resulting from operating and administration changes. Only costs directly attributable to the fare structure change were included. Other desirable capital expenditures should be attributed to other policy goals. Capital costs were presented as their annualized equivalent, on the basis of a discount rate of seven per cent (real) and appropriate asset life.

3.7 Reversibility (Risk)

For policy-makers, the most difficult decisions are those which cannot be reversed and therefore carry most risk. Options with high expected benefits need to be valued against those which are smaller and less risky, yet have smaller expected benefits.

Discounting can only account for financial effects, and it is difficult to express the uncertainties inherent in the implementation of complex projects in purely financial terms.

3.4 Reasonableness (Public Acceptability)

An essential feature for the successful implementation and working of any fares system is the level of public acceptability. This in turn relies to a great extent on the perception and understanding which the traveling public has of the rationale under-pinning the fare structure.

- o The assessment of reasonableness in this study was derived from judgement, based on experience gained at public meetings and from market research surveys regarding what is likely to be considered reasonable.
  - Such sources provide an indication of the attitude of transit riders and their understanding of the costs of public transport.
- o Projects which involve major commitments of capital investment in equipment which has little or no alternative use carry a high risk.
- o Projects for which no benefit will be derived until the project is fully complete and take a considerable time to complete were viewed as most hazardous. Often, due to rising costs, decision-makers are faced with the dilemma either of approving further capital expenditure to achieve the expected benefits, or abandoning the scheme and writing off the committed expenditure.

Large projects can be made less risky if each phase is justified independently. If projects can be implemented in this way, each phase can be re-assessed to confirm that the expected benefits will materialize before implementation. Projects of this kind need be implemented only so far as the expected benefits exceed the cost.

In general terms, this criterion evaluates the ease with which an option can be implemented or abandoned. This included non-financial factors such as institutional constraints, public relations, etc.

3.8 Equity of Fares

Of particular concern to the CTA is how options will affect the ridership of disadvantaged groups, where this may be different from the effect on average ridership. Because disadvantaged group ridership has distinct characteristics, it was important to assess whether options would have a positive or negative effect on this group of riders. The aim under this criterion was to achieve fare equity for disadvantaged ridership within the existing level of fare revenue.

3.9 Simplicity

One stated aim of CTA fare policy is to make the system simple, easily understood and convenient to use. As fare structures become more sophisticated in their attempts to discriminate between different markets, they tend to become more complicated for riders to understand. This inevitably leads to more disputes over fares and increased difficulties of enforcement, especially with manual collection methods.

3.10 Management Information

With any large transit undertaking involving large numbers of people, finance and considerable capital investment in equipment, effective control and administration are essential. Management information systems which are both reliable and appropriate to the needs of decision-makers are required. The cost of collecting and storing such information should be minimized, if overhead is to be maintained at a reasonable proportion of revenue collected.

Management information may be categorized under three main headings: Financial accounting and revenue control; Operational control; and Marketing and planning. Each option was assessed on the extent to which management information is improved, compared with the present system, under each of these three categories.

4. EVALUATION OF OPTIONS

This section summarizes the evaluation of the fare structure options within the framework described above.

- An assessment was made of the extent to which each option achieves the aims under each criterion. During this process, a score was awarded to reflect the achievement relative to the base option (the current fares structure).

- All options were awarded a score between 1 and 6, where a score of 6 indicated the better option.

- The score represented the comparative rank order of each option, rather than implying any relative value between options.

- Each of the ten criteria was then awarded an optional weighting between 0 and 100, as derived from a survey of key decision-makers - the CTA Board - to reflect the relative importance of each. These weights were varied to illustrate how the level of priority assigned to each criterion affected the value of each option.

- The option scores under each criterion were then combined to a weighted total score, which indicated the overall value of each option.

4.1 Maximize Revenue While Minimizing Loss of Ridership

To evaluate the potential of each option to increase fare revenue while minimizing ridership losses, the average overall fare for all options (including the base) was increased by 10% (Table 1). Annual revenue increases were also expressed as the ratio of dollars gained for each journey lost and each passenger-mile lost.

- It is very important to recognize the distinction between these two travel measures. In particular, the results for option 2(b) show that the reduction in passenger miles is 5.3% against a 0.5% reduction in passenger journeys, indicating a major reduction in average journey length.

A further measure for assessing the performance of each option was to assume that the maximum loss in ridership which could be tolerated was that for the base - a loss of around 3% of journeys.

- Under Option 2(c), the loss in ridership arising from the 10% overall fares increase is not significantly different from the base; hence this option has not been included in this secondary performance comparison (Table 2).

- Option 4 (Prepayment) appears to be the most effective in raising revenue, at $8 per journey lost (Table 1). However, given the complexities of the mechanism by which riders trade between cash and pass, and the difficulty of modeling this process, these results should be viewed with caution.

- The next best alternatives are Option 1 (peak/off-peak fares) and Option 3 (bus/rail fares). Both raised revenue at around $4 per journey lost.

The distance-based options had the lowest potential for revenue generation.

- Both zonal options 2(a) and 2(b) perform better than the graduated option 2(c) in raising revenue at a rate of around $3 per journey lost (Table 2), compared to around $2 per journey (Table 1).

  - This probably reflects formulation of the graduated option as purely distance-based, with no distinction of radial from local journeys.

  - If this market discrimination were added to the graduated option, its performance would improve relative to that of the zonal structures.

- Of the two zonal fare options, Option 2(a) was preferred if ridership is defined in passenger-miles, since it raised revenue at $0.46 per passenger-mile compared to $0.18.

These results suggest that applying zonal fares to the whole system would not be as effective as limiting zonal fares to the rail network only, and maintaining the existing flat fare on buses.

- This may reflect that rail journeys are generally more radial, and a zonal fare structure exploited the lower fare elasticities in this radial market.

- Scores allocated to fare structure options under Criterion 1:

1 Peak/Off-Peak	=	5
2(a) Rail zonal	=	3
2(b) System zonal	=	2
2(c) Rail Graduated	=	1
3 Bus-Rail	=	5
4 Max. Prepayment	=	(6)*

*The demand estimates of prepayment were subject to a higher level of uncertainty than the other estimates.

4.2 Maximize Ridership While Maintaining Existing Net Revenue

The options were also evaluated to assess the potential for maximizing ridership while maintaining existing net revenue. Fares were restructured in such a way that fare differentials were created that were consistent with the definition of each option.

- For instance, in the case of Option 1 (peak/off-peak), peak fares were raised while off-peak fares were reduced, such that while ridership increased, revenue remained the same (Table 3).

- For Options 2(a) and 2(b), the definition of ridership was crucial. Both options increase journeys, but passenger-miles were reduced, implying that the increased number of journeys is more than offset by a reduction in average journey length. The contrast between definitions was highlighted in Options 2(a) and 2(b), where changes in passenger-miles compared to the base were significantly larger and in the opposite direction than changes in passenger journeys.

- Option 2(c) (rail graduated) showed the least potential for increasing ridership.

- Options 1 and 3 were similar, increasing journeys by 5.1 and 6.3 million per year. These increases amounted to 1.4% - 1.7% increase over the base ridership. In terms of passenger-miles, increases were slightly lower; between 1.0% - 1.1%, indicating that the additional journeys generated were shorter than the base ridership.

This low potential was probably because this fare structure did not discriminate between local and radial markets and was based on distance alone. CTA passenger surveys found little evidence of distance influencing sensitivity to fare changes.

- Option 4 (prepayment), ranked highest in its ability to generate additional ridership. Although this result must be treated with caution, including it alongside those of the other alternative options provided an indication of possible contrasts in a common framework, if certain assumptions about prepayment are made.

The ability of prepayment to generate additional discretionary journeys, particularly in off-peak periods, is reasonably well-accepted. However, to date there has been very little hard evidence by which this effect can be quantified.

- Scores allocated to fare structure options under Criterion 2:

1 Peak/Off-Peak	=	5
2(a) Rail zonal	=	2
2(b) System zonal	=	3
2(c) Rail Graduated	=	1
3 Bus-Rail	=	5
4 Max. Prepayment	=	(6)

4.3 Option Costs

Preliminary estimates of the costs of fare structure options were made, in terms of capital investment for station modification and fare equipment purchase, and the revenue collection cost changes arising from the options (Table 4). For simplicity, the cost of each option was also expressed as the average increase in cost in cents per fare collected, compared to the existing system.

Most of the effort in preliminary cost analysis was focused on the distance-based options, since they require considerable capital investment for ticket-vending and ticket-reading machinery, as well as for associated station modifications. Rail system cost estimates were based upon preliminary analysis of approximately 30 stations, selected to represent the full range of different types in terms of age, configuration, and size. Sketch plan layouts of revised configurations of turnstile gates and agent booths were developed, to accommodate the ticket processing equipment associated with rail zonal fares and rail graduated fares. For both options, riders enter and exit the paid area via automated ticket-reading gates, with a ticket required prior to entry.

In the zonal options 2(a) and 2(b), tickets would be available from both station agents and vending machines, at all but the 28 lowest ridership stations. Roving ticket inspectors under these options would also be required to check for ticket validity. Under option 2(c), riders could obtain tickets only from vending machines.

The number of faregates required per station, particularly for busier stations, was calculated from passenger flow rates. Unit costs for all equipment associated with distance-based options were drawn from recent industry experience. The rail graduated option paralleled that now in effect at the Washington Metropolitan Area Transit System, while the rail zonal option paralleled that now in effect in London.

4.4 Other Evaluation Criteria

Ranking scores were assigned to each fare structure option for the remaining seven evaluation criteria (Table 5). Highlights regarding the highest and lowest ranking options are listed below.

4.3.1 Ease of Implementation

- Because a bus/rail differential was in effect in 1986-1987, it would be a straightforward option for re-introduction. A peak/off-peak differential ranks second, in terms of requiring very little new hardware or modification to existing equipment.

- A bus/rail system zonal fare would be the most difficult to implement, due to the considerable transition period needed for training of CTA staff, especially bus personnel, and for such a system to gain public acceptance. A rail graduated fare structure would be next most difficult, due to the extensive station modifications necessary.

4.3.2 Reasonableness (Public Acceptability)

- Distance-based fares were in general regarded as the most logical of the options, consistent with the widely accepted view that the more one consumes, the more one should pay.

- A peak/off-peak differential would have the most difficulty in gaining public acceptance. To many riders, the peak would be associated with uncomfortable rides in crowded trains and buses, possibly having to stand, and possible gaps in service---even though average service frequency was generally significantly better.

4.3.3 Revenue Protection

- Rail graduated fares would provide the greatest improvement in revenue protection, because cash-handling would be reduced, as would illegal entry to the rail system. Maximum prepayment ranked second, due to reduced cash-handling and the elimination of transfers and associated fraudulent use.

- A bus/rail system zonal fare was judged to have greatest difficulty in terms of enforcement of proper fare payments largely in relation to the extensive bus network. Crossing of zone boundaries for which additional fare payment was not received would offer major opportunity for fraud. A rail zonal fare system ranks second most difficult.

4.3.4 Reversibility (Risk)

- Re-introduction of a bus/rail differential offered the least implementation risk, followed by maximum prepayment.

- Given the high capital costs involved, a rail graduated fare structure would carry the highest risk, followed by a bus/rail system zonal fare structure.

4.3.5 Equity of Fares

- Options did not differ significantly on this criterion, though a peak/off-peak fare structure would allow those who are unemployed and/or economically disadvantaged to travel for less in the off-peak.

- Distance-based fares were judged to not impact minority disadvantaged ridership populations any differently from the average traveler. This result was based on the wide distribution of minorities as a whole and disadvantaged in particular through the service area. Poverty-level households were not concentrated in any one distance band from the Central Area, but located similarly to the total ridership.

4.3.6 Simplicity

- o A bus/rail differential ranked highest in simplicity, followed by a peak/off-peak differential.

- o In contrast, a rail graduated fare yielded a large range of different fares for the average rider to remember; stored-value tickets and bus transfer arrangements represented additional complications. A bus/rail system zonal fare would be next lowest in simplicity.

4.3.7 Management Information

- o Because of its high degree of reliance on automated ticket-reading equipment, rail graduated fares offered the greatest potential for generating improved data on station passenger flows. Rail zonal and system zonal fares ranked next.

- o Maximum prepayment and increased use of passes would be accompanied by a loss of distinction between journeys and rides taken on parts of journeys, and a degradation of routinely generated passenger flow data.

5. SUMMARY AND CONCLUSIONS

The ranking scores awarded to the various options under each criterion were combined with a set of assumed weights to represent the level of priority attached to each aim. Total scores, both weighted and unweighted, are shown at the bottom of Table 6.

- o Options 1, 3 and 4 have similar weighted scores of around 17 to 18, and therefore there is little to choose between them.

- o The distance-based options 2(a), 2(b), and 2(c) all have markedly lower weighted scores, ranging between 6 and 9. The difference between these scores and those for the other options was large, such that even a major reassignment of priority in aims would not change their rank position.

- o Comparing the distance-based options, both zonal options appear to fare better than the rail graduated option. However, if revenue protection were assigned a much higher priority this situation would change.

- o Comparing Options 1 and 3, the bus/rail option scored higher for ease of implementation, reasonableness, and reversibility. It was also less costly.

- o The peak/off-peak option ranked higher only on equity of fares. This ranking was robust to changes in priority of aims.

- o Option 4 appeared to do well, but the lower reliability of its demand estimates should be borne in mind when comparing these scores.

While Option 3 had the highest value, the difference from Option 1 was probably not significant. Peak off-peak and bus/rail fare differentials were both found to merit close further examination in future reformulation of CTA's fare structure and fare levels. These evaluation results constitute the basis for ongoing development of overall, integrated fare scenarios, now being undertaken by CTA staff.

- o The distance-based options did not appear relatively as worthwhile, as they were formulated in this study, and would probably require an alternative approach before this situation could be reversed.

- o However, the lower potential for distance-based options was principally due to the high capital costs of the fare collection equipment necessary for distance-based charging, which could not be sufficiently off-set by the additional revenue raised.

  - It was likely that the volume and complexity of such equipment will also increase maintenance costs.

  - The nature of the rail transit system in Chicago is such that there was limited scope for staff reductions at stations, despite a higher degree of automation.

  - The scope for reducing annual operating costs to offset the capital costs was not great in Chicago.

TABLE 1

EFFECT OF TEN PERCENT FARE INCREASE ON SYSTEM REVENUE AND RIDERSHIP

OPTION	AVERAGE FARE INCREASE	CHANGE IN JOURNEYS M.P.A. (%)	CHANGE IN PSGR. MILES M.P.A. (%)	CHANGE IN REVENUE $ M.P.A. (%)	REVENUE PER JOURNEY LOST $	REVENUE PER PSGR. MILE LOST $
BASE OPTION	10%	- 10.0 - 2.8%	- 56.0 - 2.7%	22.0 6.9%	2.20	0.39
1. Peak/Off-Peak	10.2%	- 6.1 - 1.7%	- 29.9 - 1.5%	26.1 8.2%	4.28	0.87
2(a) Rail Zonal	10.1%	- 7.9 - 2.2%	- 57.2 - 3.0%	21.1 6.6%	2.67	0.37
2(b) System Zonal	10.2%	- 1.9 - 0.5%	- 102.4 - 5.3%	13.6 4.3%	7.16	0.13
2(c) Rail Graduated	10.7%	- 11.0 - 3.0%	- 67.0 - 3.2%	13.6 7.5%	2.18	0.36
3. Bus/Rail	10.2%	- 5.9 - 1.6%	- 34.9 - 1.8%	25.0 7.9%	4.23	0.72
4. Prepayment	10%	- 3.5 - 1.0%	N/A	27.9 8.7%	7.97	N/A

TABLE 2

INCREASE IN SYSTEM REVENUE ASSUMING THREE PERCENT LOSS IN JOURNEYS

OPTION	AVERAGE FARE INCREASE	CHANGE IN JOURNEYS M.P.A. (%)	CHANGE IN PSGR. MILES M.P.A. (%)	CHANGE IN REVENUE $ M.P.A. (%)	REVENUE PER JOURNEY LOST $	REVENUE PER PSGR. MILE LOST $
BASE OPTION	10%	- 10.0 - 2.8%	- 56.0 - 2.7%	22.0 6.9%	2.20	0.39
1. Peak/Off-Peak	17.6%	- 10.5 - 2.9%	- 51.7 - 2.6%	43.6 13.7%	4.15	0.84
2(a) Rail Zonal	13.8%	- 10.3 - 2.8%	- 65.9 - 3.0%	30.7 6.6%	2.98	0.46
2(b) System Zonal	19.9%	- 10.1 - 2.8%	- 160.1 - 8.3%	28.7 9.0%	2.84	0.18
2(c) Rail Graduated	N/A	N/A	N/A	N/A	N/A	N/A
3. Bus/Rail	17.9%	- 10.3 - 2.8%	- 61.1 - 3.2%	42.0 13.2%	4.08	0.69
4. Prepayment	*	*	*	*	*	*

*Note: It was difficult to achieve a 3% reduction in journeys under this option. The figures derived were insufficiently robust for analysis.

M.P.A. = Million per annum.

TABLE 3

RIDERSHIP CHANGES ASSUMING NO CHANGE IN SYSTEM REVENUE

OPTION	CHANGE IN JOURNEYS M.P.A. (%)	CHANGE IN PSGR. MILES M.P.A. (%)	CHANGE IN REVENUE* M.P.A. (%)
1. Peak/Off-Peak	5.1 1.4%	21.5 1.1%	Ø.94 Ø.3%
2(a) Rail Zonal	2.7 Ø.7%	- 8.9 - Ø.5%	Ø.Ø2 -
2(b) System Zonal	6.1 1.7%	- 52.4 - 2.7%	Ø.5Ø Ø.2%
2(c) Rail Graduated	Ø.32 -	13.Ø Ø.6%	Ø.36 Ø.ØØ1%
3. Bus/Rail	6.3 1.7%	2Ø.1 1.Ø%	Ø.22 Ø.Ø7%
4. Prepayment	42.1 6.8%	N/A	Ø.Ø6 -

*Note: The tests conducted aimed to achieve a zero change in revenue. This column indicates the actual change in revenue.

M.P.A. = Million per annum.

TABLE 4

PRELIMINARY COSTS OF FARE STRUCTURE OPTIONS

Estimated Range

OPTION	CAPITAL COST $ (MILLION)	ANNUALIZED EQUIVALENT OF CAPITAL $ M.P.A.	OPERATING REVENUE COLLECTION COST $ M.P.A.	TOTAL ANNUAL COST $ M.P.A.	COST PER FARE
1. Peak/Off-Peak	0.41 - 0.81	0.03 - 0.07	-	0.03 - 0.07	0.01 - 0.02
2(a) Rail Zonal	40.68 - 55.44	3.37 - 4.60	2.03 - 2.77	5.41 - 7.37	1.73 - 2.35
2(b) System Zonal	49.68 - 68.94	4.12 - 5.72	4.98 - 5.95	9.10 - 11.66	2.91 - 3.73
2(c) Rail Graduated	67.28 - 92.08	5.58 - 7.64	3.36 - 4.60	8.94 - 12.24	2.86 - 3.91
3. Bus/Rail	-	-	0.38	0.38	0.12
4. Prepayment	0.75 - 1.25	0.18 - 0.29	2.84 - 3.71	3.02 - 4.00	0.96 - 1.28

Note: Costs are estimated in 1987 constant dollars.
M.P.A. = million per annum.

TABLE 5

SUMMARY OF RANKING SCORES: OTHER EVALUATION CRITERIA

CRITERION	1 PEAK/ OFF PEAK	2(a) RAIL ZONAL	2(b) SYSTEM ZONAL	2(c) RAIL GRADUATED	3 BUS/ RAIL	4 PREPAY.
1. Ease of implementation	5	3	1	2	6	4
2. Reasonableness	1	5	6	5	3	2
3. Revenue protection	4	2	1	6	4	5
4. Reversibility	4	3	2	1	6	5
5. Equity of fares	6	3	3	3	5	5
6. Simplicity	5	3	2	1	6	4
7. Management Information	3	5	5	6	3	1

TABLE 6

OVERALL OPTION SCORES: WEIGHTED AND UNWEIGHTED

CRITERION	WEIGHT	1 PEAK/ OFF PEAK	2(a) RAIL ZONAL	2(b) SYSTEM ZONAL	2(c) RAIL GRADUATED	3 BUS/ RAIL	4 PREPAY.	BASE
1. Max revenue, riders const.	80	5	3	2	1	5	6	0
2. Max ridership, rev. const.	80	5	2	3	1	5	6	0
3. Ease of implementation	20	5	3	1	2	6	4	7
4. Reasonableness	10	1	5	6	5	3	2	0
5. Revenue protection	25	4	2	1	6	4	5	4
6. Cost	80	5	3	1	2	6	4	7
7. Reversibility	20	4	3	2	1	6	5	7
8. Equity of fares	20	6	3	3	3	5	5	3
9. Simplicity	10	5	3	2	1	6	4	7
10. Management Information	5	3	5	5	6	3	1	0
UNWEIGHTED:		43	32	26	28	49	42	35
WEIGHTED SCORES:		16.8	9.7	7.3	6.8	18.3	17.5	10.7

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